

B/CS Unified Technical Specifications

***Water, Sewer, and Generals
2004***



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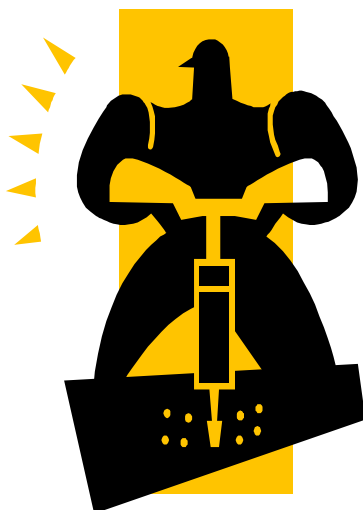
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TECHNICAL SPECIFICATIONS

General



SPECIFICATION NO. 110

PIPE BORING, JACKING, TUNNELING AND ENCASEMENT

110.01 DESCRIPTION

The work to be performed under this Specification shall consist of furnishing and installing all materials and equipment and performing all labor required to install pipelines crossing under highways, railroads, and streets by boring, jacking, and tunneling, as specified herein. **All sewer bores will be accomplished by dry mechanical bore unless otherwise approved by the Engineer.** Water line bores may utilize the wet boring technique. All carrier pipes within the encasement conduit shall be restrained joint pipe of the type specified on the plans, or approved by the Engineer.

When the work per this item falls within a TxDOT or Railroad right of way, the stricter of the applicable standards apply. This requirement includes all insurance, notification, permitting, signage, etc. required by the right of way owner.

110.02 MATERIALS

Steel Pipe, Ductile Iron Pipe, Reinforced Concrete Pipe, and PVC Pipe may be used as encasement material, unless otherwise shown on the plans. The nominal inside diameter of the encasement pipe shall be as indicated below, unless otherwise shown on the plans.

A. Steel Pipe

Encasement pipe shall conform to ASTM Specification A134, Mild Carbon Steel, A139, Grade A, or AWWA C200-91 Grade B, butt-welded joints with entire circumference welded by a certified welder shall be in accordance with AWWA C200-86 Section 3. All steel casing shall have a wall thickness as shown in the table below:

Carrier Pipe Nominal Diameter	Casing Pipe Nominal Diameter	Casing Pipe Minimum Thickness ¹
6"	14"	3/8"
8"	16"	3/8"
12"	20"	3/8"
15"	24"	3/8"
18"	26"	3/8"
24"	32"	1/2"

1. Casing Pipe Thickness for Railroad crossings shall be a minimum of 1/2-inch thick regardless of diameter.

B. Ductile-Iron Pipe

Encasement pipe shall conform to the current AWWA C150 and C151 standards. Pipe shall be thickness Class 250 or greater, unless otherwise shown on the plans.

C. Reinforced Concrete Pipe

Encasement pipe shall conform to the current ANSI C-76 standards. Pipe shall be Class III or IV, unless otherwise shown on the plans.

D. PVC Pipe

Encasement pipe shall conform to the current ASTM D2241 or AWWA C905 standards. Pipe shall be DR 26 or SDR 26, unless otherwise shown on the plans. PVC pipe shall be used only when specified on the plans.

E. Grout

Grout shall be in accordance with Specification 152.

F. Casing Spacers

Stainless Steel casing spacers shall be required in all casing pipes. The casing spacers shall be affixed to the carrier pipe at a spacing of 6'8" or per the manufacturers recommendations if less than 6'8".

G. End Seals

End seals shall be 1/8" thick synthetic rubber secured with stainless steel banding straps. Other end seals shall be constructed only as approved by the engineering inspector.

110.03 SUBMITTALS

- A. Submit manufacturer's product data on encasement pipe.
- B. Submit manufacturer's "Certificate of Compliance" to this part of the specifications for materials furnished for the project.
- C. The Contractor or subcontractor performing the work described under this section shall demonstrate technical skill and experience in previous work of this nature. Work experience shall be submitted to the Engineer.
- D. Casing spacer data sheets demonstrating compliance with this specification.

110.04 CONSTRUCTION METHODS

110.04.1 ENCASEMENT REQUIREMENTS

Encasement pipe shall be required for all water mains crossing major collector and arterial street crossings and all water mains 12" and greater crossing any roadway. Encasement pipe for sewer mains shall be placed as required by the City Engineer. The casing pipe shall extend two feet (2') beyond the back of curb. Encasement pipes may be installed by open cut with the approval of the engineer.

110.04.2 BORE AND TUNNEL PITS

Unless more stringent requirements regarding location of bore and tunnel pits are noted on the plans, or are required by TXDOT, Railroad, County, or City, to conform to the requirements that follow:

1. The Conduit to be installed by boring, jacking and tunneling shall extend to distances as shown in the Standard Details.

2. If necessary to prevent cave-ins, sheet, shore, or brace the pit in accordance with OSHA regulations. All pits shall be covered with 1/2" thick steel plates. Steel plates shall be on-site prior to excavating the pit.
3. General: Unless otherwise noted, extend auger hole 10 feet beyond edge of pavement, railroad tie, or other structure. The hole is to be bored mechanically, using a pilot hole. An approximate 2-inch hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings, jetting will not be permitted.

In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10 percent of high-grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter. Overcutting in excess of one inch shall be remedied by pressure grouting the entire length of the installation.

110.04.3 CONSTRUCTION METHODS FOR DRY BORING

1. All sewer bores will be accomplished by dry mechanical bore unless otherwise approved by the Engineer.
2. Only workmen experienced in boring operations shall perform the work.
3. The use of water or other fluids in connection with the boring operation will NOT be permitted.
4. The casing pipe shall be placed in the bore hole simultaneously while boring is being performed. Installing the encasement conduit immediately by pulling it in place from opposite the boring machine or by jacking the conduit through the bore is not acceptable. Take proper care to secure the joints of the conduit as subsequent sections are installed by welding joints. Provide a steel rail or timber cradle in the pit to support and guide the conduit in its installation.
5. If after completion of the installation of the conduit, there is more than one inch (1") clearance between the outside of the barrel of the conduit and the wall of the bore, grouting of these voids will be required. If during construction of the bore, a cave-in occurs within the bore, grouting of the voids between the conduit and the walls of the bore will be required throughout the length of the bore.
6. Conform to the requirements of the Texas Department of Transportation, Railroad Company, County, or City having jurisdiction over the right-of-way involved, as to details of construction methods and time of construction. All work necessary to meet the requirements of the Texas Department of Transportation, Railroad Company, County, or City will be considered incidental to the installation of the pipeline in the right-of-way. The Contractor shall abide by the more stringent of these specifications, or the specifications of the regulatory agencies.

110.04.4 CONSTRUCTION METHODS FOR WET BORING

1. All sewer bores will be accomplished by dry mechanical bore unless otherwise approved by the Engineer. (see above)
2. Only workmen experienced in boring operations shall perform the work. A pilot hole must be successfully completed to the satisfaction of the engineer prior back reaming the bore.
3. The use of water or other fluids in connection with the boring operation will be permitted only to lubricate cuttings. Jetting will not be permitted. In consolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least ten (10%) percent of high-grade bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and lubricate removal of cuttings and installation of the pipe immediately thereafter.
4. While boring is being performed, install the encasement conduit immediately by pulling it in place from opposite the boring machine or by jacking the conduit through the bore. Encasement conduit may be placed after the boring operation is complete, if permission is obtained from TXDOT, the railroad company, the City, or the County. Take proper care to secure the joints of the conduit as subsequent sections are installed, by use of cables or welding joints. Provide a steel rail or timber cradle in the pit to support and guide the conduit in its installation.
5. If after completion of the installation of the conduit, there is more than one inch (1") clearance between the outside of the barrel of the conduit and the wall of the bore, grouting of these voids will be required. If during construction of the bore, a cave-in occurs within the bore, grouting of the voids between the conduit and the walls of the bore will be required throughout the length of the bore.
6. Grouting material and equipment shall be on the jobsite before beginning installation of the conduit, in order that the grouting around the encasement conduit is to be started immediately after pipe is in place.
7. Conform to the requirements of the Texas Department of Transportation, Railroad Company, County, or City having jurisdiction over the right-of-way involved, as to details of construction methods and time of construction. All work necessary to meet the requirements of the Texas Department of Transportation, Railroad Company, County, or City will be considered incidental to the installation of the pipeline in the right-of-way. The Contractor shall abide by the more stringent of these specifications, or the specifications of the regulatory agencies.

110.04.5 CONSTRUCTION METHODS FOR JACKING

1. Unless otherwise specified, the methods and equipment used in jacking conduit shall be the Contractor's option, provided that the proposed method is approved by the Engineer. Such approval, however, shall in no way relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein.
2. If, after completion of the installation of the conduit, there is more than one (1") inch clearance between the outside of the barrel of the conduit and the wall of the tunnel, the Contractor shall completely grout the conduit in place throughout its entire

length. If, during the jacking operation, a cave-in occurs, the Contractor shall grout the entire conduit in place throughout its entire length.

110.04.6 CONSTRUCTION METHODS FOR TUNNELING

1. Excavate the tunnel in such a manner and to such dimensions that will permit placing of the proper supports **in accordance with OSHA Regulations** necessary to protect the excavation. Make adequate provisions for the safety and health of the workmen. Use only air or electric powered equipment in the tunnel. Provide adequate illumination and ventilation.
2. Excavate only enough earth to allow installation of the tunnel liner plate. Remove earth from within tunnel and install the next section of tunnel liner plates.
3. After completion of the tunnel, or at intervals directed by the Engineer, grout the entire void between the tunnel lining. If after completion of the tunnel there are sags in invert of the liner that exceed 0.2 feet of a straight line projected through the tunnel, grout the invert to eliminate the sags.

110.04.7 SPECIAL PROVISIONS FOR BELL & SPIGOT ENCASEMENT PIPE

Where pipe using bell and spigot joints is installed as encasement pipe, completely grout the voids between the outside of the encasement pipe and the inner wall of the bore or tunnel throughout the length of the pipe. If directed by the City Engineer, the joints shall be welded to prevent the joints from slipping with respect to each other.

110.04.8 SUPPORT OF PIPES ACROSS BORE OR TUNNEL PITS

After completion of the bore or tunnel and installation of the carrier pipe with the bore or tunnel, remove all loose earth and debris from the pit down to undisturbed earth. Pour a continuous 2,000 psi concrete or cement stabilized sand support under the carrier pipe from the edge of the bore or tunnel to the first joint in the trench past the end of the pit. The concrete support shall be brought up to the horizontal centerline of the pipe.

110.04.9 CARRIER PIPE

Carrier pipe may be pushed or pulled through the completed encasement pipe. Casing spacers by Cascade Waterworks or approved equivalent should be placed on the carrier pipe to insure approximate centering within the encasement pipe and to prevent damage during installation. Care must be exercised in order to avoid metal-to-metal contact. The ends of the encasement pipe will be sealed with rubber seals and stainless steel bands. In order to avoid the transfer of earth and live loads to the carrier pipe, the space between the carrier pipe and encasement pipes shall not be filled completely.

All carrier pipe installed within a casing shall be restrained. The restrained section shall extend at least five feet (5') beyond both ends of the casing pipe. Lock joint pipe, retainer glands, or restrainer gaskets may be used for this application.

When ductile iron pipe is used for the carrier pipe, all ductile iron pipe shall be poly-wrapped per the specifications.

110.04.10 SPOILS

Spoil locations shall be approved by the engineering inspector. When no suitable location for spoil can be found on site, the contractor shall be required to haul and dispose of this material at no extra cost. Where spoils are to be placed on parking areas (asphalt or concrete), sidewalks, or other paved surfaces, the spoils shall be placed on a barrier to prevent the soil from embedding into the paved surface.

110.05 TESTING REQUIREMENTS

A. Allowable Tolerances

Where grades or elevations are shown on the plans for the pipeline to be installed by boring, jacking, and tunneling operations, maximum deviation of plan elevation shall be 0.2 foot. The maximum deviation of alignment over the length of the bore shall be 0.2 foot. The Engineer shall determine the corrective action to be taken for tolerances above those stated in this specification.

110.06 MEASUREMENT

A. Measurement

1. Openings provided by boring, jacking, and tunneling (including carrier pipe) will be measured by the linear foot along the centerline of the opening, as measured from end of pipe to end of pipe placed by boring, jacking and tunneling. There will not be any classification for payment according to depth.
2. Concrete support slab in the pits and all other work necessary to meet the requirements of the Texas Department of Transportation, railroad company, County, and City will not be measured.
3. Openings provided by boring, jacking and tunneling will be paid for at the unit price bid per linear foot. The unit price bid for boring jacking and tunneling shall be full compensation for furnishing and placing all materials, labor, tools, carrier pipe, carrier pipe restraint, casing spacers, equipment, pits, concrete support slabs and incidentals necessary to complete the work.

SPECIFICATION NO. 120

CONCRETE BLOCKING OR ANCHORAGE

120.01 DESCRIPTION

This section covers the manufacture of materials and installation of concrete blocking or anchorage for thrust resistance. Concrete blocking shall be placed at bends, tees, crosses, fire hydrants, plugs, etc. in the supply line. Blocking shall also be installed for blow-offs as shown on the plans or as directed by the Engineer.

120.02 MATERIALS

- A. Cement shall conform to the current ASTM C150 standard and be Type I.
- B. Aggregates shall conform to the current ASTM C33 standard.
- C. Concrete strength shall be at least 2,000 psi at twenty-eight (28) days, unless otherwise shown on the plans. Concrete for blocking shall be of a quality and placed in accordance with Specification No. 150, "Concrete for Structures." The concrete for blocking shall be class 2,000 psi concrete (class "C").
- D. 3,000 psi sack-crete may be used but must be hydrated prior to placement.

120.03 SUBMITTALS

(NOT USED)

120.04 CONSTRUCTION METHODS

120.04.01 THRUST RESTRAINT

1. Hydrants

The bowl of each hydrant shall be well braced against a sufficient area of unexcavated earth at the end of the trench with concrete backing, or it shall be tied to the pipe with restrained joints as shown or directed by the City.

Tie rods, clamps, or other components of dissimilar metal shall be protected against corrosion by encasement of the entire assembly with 8-mil thick, loose polyethylene film in accordance with AWWA C105.

Thrust restraint design pressure should be equal to 200 psi.

2. Fittings

The contractor shall install concrete blocking **and** retaining glands to all tees, Y-branches, bends deflecting eleven and one-fourth degrees ($11\frac{1}{4}^{\circ}$) or more, and plugs which are subject to internal pressure in excess of 10 psi. to preclude separation of joints.

If stainless steel is not used, the contractor shall protect from corrosion all steel clamps, rods, and other metal accessories used in reaction anchorages, or joint harnesses subject to submergence, or in direct contact with earth and not encased in

concrete with epoxy coating or wrapped with 8 mil. polyethylene film. All bolts and nuts shall be 316 Stainless Steel.

3. Restraint Materials

Vertical and horizontal reaction backing shall be made of concrete having a compressive strength of not less than 2,000 psi after twenty-eight (28) days.

Backing shall be placed between solid ground and the fitting to be anchored; the area of bearing in the pipe and on the ground in each instance shall be that shown on the plans or directed by the City. The backing shall, unless otherwise shown or directed, be so located as to contain the resultant thrust force, and so that the pipe and fitting joints will be accessible for repair.

Mechanical joints utilizing set-screw retainer glands (DIP only, use Megalug or approved equal for PVC), or metal harness of tie rods or clamps shall be used **in addition to** concrete backing. Components of dissimilar metal shall be protected against corrosion by encasement of the entire assembly with 8-mil thick, loose polyethylene film in accordance with AWWA C105.

120.04.2 PLACING CONCRETE BLOCKING

Extend 2,000 psi concrete blocking from the fitting to solid, undisturbed earth and install so that all joints are accessible for repair. The bearing area shall be as shown on the plans. If no details regarding blocking are shown on the plans, provide enough concrete bearing against the ditch to limit soil loading to 200 psf from the thrust produced at an internal pressure in the pipe of 200 psi.

Concrete shall not be placed unless all pipes, valves, fittings, forms, and reinforcement have been inspected.

Handle all concrete in such a manner to avoid segregation, separation, or loss of ingredient, or the displacement of piping, etc.

Place concrete in continuous horizontal layers not exceeding 24". Place each layer quickly enough so that the previously placed concrete is still plastic when the next layer is placed. Provide any construction joints that are necessary.

Before beginning the placement of concrete, inspect all forms, pipes, fittings, valves, etc. for alignment and rigidity. Tighten all supports and make corrections to alignment as required. Inspect all reinforcement, if any, for placement and rigidity.

Do not begin placing concrete until all forms and reinforcement have been inspected by the Engineer.

Clean all loose dirt, mud, water, and debris from the trench and forms. All surface encrusted with hardened concrete from previous placement operations shall be clean.

Clean all pipe, fittings, valves, etc. projecting from previously placed concrete before placing new concrete.

Accurately and securely place all embedded items.

120.05 TESTING REQUIREMENTS

(NOT USED)

120.06 MEASUREMENT

Restrained joints, fittings, and concrete blocking shall not be a separate bid item. Cost for work herein specified, including the furnishing of all materials, equipment, labor, and incidentals necessary to complete the work, shall be included in the unit price for water or sanitary sewer lines in place.

SPECIFICATION NO. 130

EXCAVATING, TRENCHING, AND BACKFILLING

All excavation will meet the most current OSHA Regulations. See Specification No. 131 for trench safety requirements.

130.01 DESCRIPTION

The work to be performed under this Specification shall consist of furnishing all labor, equipment and materials and performing all operations in connection with the excavating, trenching, and backfilling for pipelines as shown on the plans and as specified herein.

130.02 MATERIALS

A. Materials for pipe embedment will meet TCEQ Regulations for depth of bury and class of pipe and City of Bryan Embedment Details as shown on the Plans.

B. Concrete (For encasement or blocking) See Specification No. 150.

Material shall conform to ASTM C94. The compressive strength of the concrete shall be at least 2,000 psi and shall contain at least four (4) sacks of cement per cubic yard.

C. Cement stabilized sand. See Specification No. 135.

130.03 CONSTRUCTION METHODS

130.03.1 CONTROL OF WATER

Provide sufficient pumping equipment, in good working order, available at all times to remove any water that accumulates in excavations. When the excavation crosses a drainage pathway, the contractor shall provide for means of alternate drainage. The discharge of dewatering equipment shall not cause damage to private or public property.

130.03.2 SHEETING, SHORING, AND BRACING

See Specification No. 131.

In caving ground, or in wet, saturated, or flowing materials, the contractor shall sheet, shore, or brace the sides of the trench so as to maintain the excavation properly in place. When excavations are made adjacent to existing building or other structures or in paved streets, particular care must be taken to adequately sheet, shore, and brace the sides of the excavation to prevent undermining of, or settlement beneath, the structures or pavement. Underpinning of adjacent structures or pavement shall be done by the Contractor at his own cost and expense, in a manner satisfactory to the Engineer and when required by the Engineer. The pavement shall be removed, the void satisfactorily refilled and compacted, and the pavement replaced by the Contractor. The entire expense of such removal and subsequent replacement thereof shall be borne by the Contractor. Sheeting, shoring, and bracing shall not be left in place, unless otherwise provided for in the contract or authorized by the Engineer. The removal of sheeting, shoring and bracing shall be done in such a manner as not to endanger or damage either new or existing structure, private or public properties, and so as to avoid cave-ins or sliding of the banks. All holes or voids

left by the removal of the sheeting, shoring, or bracing shall be immediately and completely filled and compacted with suitable materials.

130.03.3 GUARANTEE

1. Guarantee the backfilling of excavation and trenches against settlement for a period of one (1) year after the final completion of the contract under which the work is performed.
2. Make all repairs or replacements made necessary by settlement, including refilling, compacting, and reseeding or resodding the upper portion of the ditch and repairing broken or settled pavements, driveways, and sidewalks within five (5) days after notice from the Engineer.

130.03.4 PREPARATION

1. Site Preparation

Prepare the construction site for construction operations by removing and disposing of all obstructions and objectionable materials in accordance with contract documents.

2. Alignment, Grade and Minimum Cover

a. General

The water and sewer mains shall be laid and maintained to lines and grades established by the plans and specifications with fittings, valves, hydrants, manholes and clean-outs at the required locations, unless otherwise approved by the Engineer. Valve-operating stems shall be oriented in a manner to allow proper operation. Hydrants shall be installed plumb.

- b. Cut sheets shall be provided to the City's Inspector. The contractor shall determine the alignment and grade or elevation of the pipeline from offset stakes. The contractor shall also provide a continuous chalk line along the alignment of the trench for use by the operator of the excavating equipment. The contractor shall provide a laser beam and grade pole to assist in grading the ditch to the proper elevation.

- c. Should the ditch be graded below the required elevation, bring subgrade to the required elevation with cement stabilized sand or rounded pea gravel. The use of excavating materials for this application will not be allowed.

- d. Where pipe grades or elevations are not definitely fixed by contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the pipe. Greater pipe cover depths may be necessary for clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevations.

3. Prior Investigation

Prior to excavation, investigation shall be made to the extent necessary to determine the location of existing underground structures and conflicts. Care should be exercised by the Contractor during excavation avoid damage to existing structures.

4. Unforeseen Obstructions

When obstructions that are not shown on the plans are encountered during the progress of work and interfere so that an alteration of the plans is required, the Engineer will alter the plans or order a deviation in line and grade or arrange for removal, relocation or reconstruction of the obstructions.

5. Clearance

When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the approval of the Engineer, to provide clearance as required by federal, state or local regulations or as deemed necessary by the Engineer to prevent future damage or contamination of either structure.

130.03.5 EXCAVATION

All excavation shall meet the most current OSHA regulations.

1. Classification

Excavation of trenches for pipelines is unclassified. Soils will be classified utilizing OSHA Standards and Regulations. The Contractor shall assume that the site contains the worse type of soils and make provisions for shoring the work area.

2. Trench Excavation

a. General

The trench shall be excavated to the required alignment, depth and width and in conformance with all federal, state and local regulations for the protection of the workmen.

b. Trench Preparation

- i) Trench preparation shall proceed in advance of pipe installation for only as far as pipe will be laid that day.
- ii) The contractor shall keep the trench dry from both storm water and seepage from the sides of the trench. Discharge from any trench dewatering pumps shall be conducted to natural drainage channels, storm sewers or an approved reservoir. Do not discharge into any municipal sewer system without municipal approval. The contractor shall be responsible for cleaning any storm drain system, which was used for dewatering discharge.
- iii) Excavated material shall be placed in a manner that will not obstruct the work nor endanger the workmen, obstruct sidewalks, driveways, or other structures and shall be done in compliance with federal, state, or local regulations.

3. Pavement Removal

Removal of pavement and road surfaces shall be a part of the trench excavation, and the amount removed shall depend upon the width of trench required for installation of the pipe and the dimensions of area required for the installation of valves, hydrants, specials, manholes or other structures. The dimensions of pavement removed shall not exceed the dimensions of the opening required for installation of pipe, valves, hydrants, specials, manholes and other structures by more than twelve (12") inches in any direction, unless otherwise required or approved by the Engineer.

4. Width

See City Standard Trench Detail.

5. Bell Holes

Holes for the bells shall be provided at each joint, but shall be no larger than necessary for joint assembly and assurance that the pipe barrel will lie flat on the trench bottom. Other than noted previously, the trench bottom shall be true and even in order to provide support for the full length of the pipe barrel, except that a slight depression may be provided to allow withdrawal of pipe slings or other lifting tackle.

6. Subgrade in Earth

- a. Where a firm and stable foundation for the pipe can be obtained in the natural soil, and where special embedment is not shown on the plans, or specified herein, carefully and accurately trim the bottom of the trench to fit the lower portion of the pipe barrel. The bottom of the trench shall be firm, stable and free of standing water.
- b. If water is allowed to collect in an originally dry trench after a reasonable time has passed to complete the embedment of the pipe, as determined by the Engineer, the contractor shall place a minimum of four (4") inches of clean rounded pea gravel in the ditch and pump out all accumulated water before placing the pipe. No deleterious materials will be allowed in the gravel. No extra compensation will be allowed for this work.
- c. Where wet, soft, or spongy material is encountered in the excavation at subgrade level, the contractor shall remove such material at the direction of the Engineer and replace it with crushed stone of sufficient quantity such that when fully compacted, the subgrade is firm and stable.

7. Subgrade in Rock

- a. When excavation of rock is encountered, all rock shall be removed to provide a clearance of at least six (6") inches below and on each side of all pipe, valves and fittings for pipe sizes twenty-four (24") inches or smaller, and nine (9") inches for pipe sizes thirty (30") inches and larger. When excavation is completed, the proper embedment material shall be placed on the bottom of the trench to the previously mentioned depths, leveled and tamped.
- b. These clearances and bedding procedures shall also be observed for pieces of concrete or masonry and other debris or subterranean structures, such as masonry walls, piers or foundations that may be encountered during excavation.
- c. The installation procedures specified in this section shall be followed when gravel formations containing loose boulders greater than eight (8") inches in diameter are encountered.
- d. In all cases, the specified clearances shall be maintained between the bottom of all pipe and appurtenances and any part, projection or point of rock, boulder or stones of sufficient size and placement, which, in the opinion of the Engineer, could cause a fulcrum point.

130.03.6 CONCRETE ENCASEMENT

The Contractor shall place 2,000 psi concrete encasement under and around pipe as shown on the embedment detail, and provide necessary anchors to prevent the pipe from floating out of place. The contractor shall remove and relay any pipes that are floated out of proper position

130.03.7 BACKFILLING

1. General

- a. The Contractor shall not begin backfilling until approval has been obtained from the Inspector. Backfilling includes refilling and consolidation of the fill in trenches and excavations up to the natural ground surface or road grade.
- b. Backfill shall be accomplished in accordance with the specified laying condition as shown on the plans.

2. Backfill Material

- a. All backfill material shall meet latest edition of ASTM D2321 unless otherwise specified by the Engineer.
- b. If excavated material is indicated on the drawings or specified for backfill, and there is a deficiency due to a rejection of part thereof, the contractor shall provide the required amount of sand, gravel or other approved material.

3. Do not leave trenches open overnight without backfilling to the natural ground level. Steel plates (1/2" in thickness) may be used to cover open trenches only with the approval of the Engineer.

4. Compaction

Compaction requirements are as specified on the plans.

130.04 TESTING REQUIREMENTS

Compaction tests for all backfill may be required for every 200 linear feet of trench and for each twelve-inches (12") vertically. Density tests, shall be measured as one unit for each test. The Owner shall pay for Geotechnical tests ordered that meet the requirements of the plans and specifications. Failed tests shall be charged to the Contractor. Refer to City Standard Trench Detail for compaction effort requirements.

130.05 MEASUREMENT

All trench excavation, backfill and compaction are not considered pay items. Payment for these items shall be included in the unit price laid in the Proposal for each size of pipe at their respective depths. This unit price shall be full remuneration for performing the trench and backfill complete including grading, bell holes, sheeting, dewatering, tamping, and water soaking; and including the furnishing of sewer pipe, all equipment, labor, materials, power, teams, tools, and transportation necessary or incidental thereto; but not including tunneling, or boring, all of which will be paid for extra.

SPECIFICATION NO. 131

TRENCH SAFETY

131.01 DESCRIPTION

The work specified under this section requires the Contractor to provide for the safety of the workmen in strict compliance with 29 CFR Part 1926 1993 (Revised as of July 1, 1996 of latest Edition or Revision to) Excavations and Applicable Subparts. The submission of a "TRENCH SAFETY PLAN" which shall fully satisfy the requirements of this specification is required prior to a notice to proceed to start the project.

131.02 MATERIALS

A. Materials

1. Timber

Trench sheeting materials shall be full size, a minimum of 2 inches in thickness, solid and sound, free from weakening defects such as loose knots and splits.

2. Sheet Piling

Steel sheet piling shall conform to one or more of ASTM A328/328M, ASTM A572/A572M/ ASTM A690/A690M material requirements.

3. Structural Steel

Steel for stringers (wales) and cross braces shall conform to ASTM A588.

4. Trench Boxes

Steel trench Boxes to be constructed of steel conforming to ASTM A36/A36M. Connecting bolts used to conform to ASTM A307. Welds shall conform to the requirements of AWS D1.1.

5. Miscellaneous

Miscellaneous materials to be utilized shall conform to applicable ASTM standards.

B. Referenced Specifications

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

American Society of Testing and Materials (ASTM)

ASTM A36/A36M	1997 Standard Specification for Carbon Structural Steel
ASTM A307	1997 Revision A-Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile length
ASTM A328/A328M	1996 (REV) Standard Specification for Steel Sheet Piling
ASTM A572/A572M	1997 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality

ASTM A588/A588M	1997 Standard Specification for High-Strength Low-Alloy Structural Steel With 50 ksi (345 MPa) Minimum Yield Point to 4 inch (100 mm) thick
ASTM A690/A690M	1994 Standard Specification for High-Strength Low-Alloy Steel H-Pipes and Sheet Piling for Use in Marine Environments
American Welding Society, Inc. (AWS)	
AWS D1.1	1998 Structural Welding Code-Steel

OCCUPATION SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR Part 1926	1993 (Revised as of July 1, 1996 of latest Edition or Revision to) Excavations and Applicable Subparts
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131.03 SUBMITTALS

A. Certificates

Submit manufacturer's "Certificate of Compliance," stating that the devices (trench boxes, speed shoring, etc.) to be used for trench safety comply with the requirements of this specification. The certificate should show the design assumptions and limitations of the device and should be sealed by an engineer registered and licensed to practice in the state of Texas.

B. Trench Safety Plan

Submit a detailed TRENCH SAFETY PLAN for all work areas. Calculations shall be provided for any areas beyond the capacity of the trench box or speed shoring and sealed by an engineer registered and licensed to practice in the state of Texas. This plan shall include evacuation routes for personnel.

131.04 CONSTRUCTION METHODS

A. General:

The trench safety system shall be constructed, installed and maintained in accordance with the Trench Safety Plan as outlined in 131.03. Bed and backfill pipe to a point at least one (1) foot above top of pipe or other embedded items prior to removal of any portion of trench safety system. Bedding and backfill shall be in accordance to other applicable Specification Sections. Backfilling and removal of trench supports shall be in accordance with Contractor's Trench Safety Plan. Removal of trench safety system to be accomplished in such a manner to cause no damage to pipe or other embedded items. Remove no braces or trench supports until all personnel have evacuated the trench. The trench shall be backfilled to within 5 feet of natural ground prior to removal of entire trench safety system.

B. Supervision:

Provide competent supervisory personnel at each trench while work is in progress to ensure Contractor's methods, procedures, equipment and materials pertaining to the safety systems in this Section are sufficient to meet requirements of OSHA Standards.

C. Inspection:

The CONTRACTOR shall make daily inspection of trench safety system to ensure that the system meets OSHA requirements. Daily inspection shall be made by competent personnel. If evidence of possible cave-ins or slides is apparent, all work in the trench is to cease until necessary precautions have been taken to safeguard personnel entering trench. The CONTRACTOR shall maintain permanent record of daily inspections.

D. Timber Sheeting

Timber sheeting and size of uprights, stringers (wales,) and cross bracing to be installed in accordance with the TRENCH SAFETY PLAN. Place cross braces in true horizontal position, spaced vertically, and secure to prevent sliding, falling or kick outs. Cross braces to be placed at each end of stringers (wales) in addition to other locations required. Cross braces and stringers (wales) to be placed at splices of uprights, in addition to other locations required.

E. Steel Sheet Piling

Steel sheet piling of equal or greater strength may be used in lieu of timber trench shoring shown in the OSHA tables (proposed standards). Drive steel sheet piling to a least minimum depth below trench bottom as recommended by CONTRACTOR's Registered Licensed Professional Engineer providing design. Place cross braces in true horizontal position and spaced vertically. Secure to prevent sliding, falling, or kick outs. Cross braces to be placed at each end of stringers (wales), in addition to other locations required.

F. Maintenance of Safety System

The safety system to be maintained in the condition as shown on the Trench Excavation and Shoring Safety Plan as designed by the CONTRACTOR's Registered Licensed Professional ENGINEER. The CONTRACTOR shall take all necessary precaution to ensure the safety systems are not damaged during their use. If at any time during its use a safety system is damaged, personnel to be immediately removed from the trench excavation area and the safety system repaired. The CONTRACTOR is to take all necessary precautions to ensure no loads, except those provided for in the plan, are imposed upon the trench safety system.

131.05 TESTING REQUIREMENTS

(NOT USED)

131.06 MEASUREMENT

A. Measurement

Measure "Trench Safety" as shown on the bid proposal. Shoring of trench at manholes and other unusual structures to be included in this cost.

B. Payment

Pay for "Trench Safety" as shown on the bid proposal. Payment to be full compensation for all work described herein. There will be no increase in the Contract price because of the incorporation of CONTRACTOR's Trench Safety Plan or CONTRACTOR's detailed plans and specifications for the trench safety system into the bid documents and the Construction Contract. There will be no increase in the Contract price because of modifications to CONTRACTOR's plan and/or the CONTRACTOR's detail plans and specifications for the

trench safety system, whether or not the result of unforeseen or differing site or soil conditions.

“Trench Safety Plan” shall be included as part of the “Trench Safety” bid item and shall not be paid for as a separate pay item.

SPECIFICATION NO. 135

CEMENT STABILIZED SAND BACKFILL

135.01 DESCRIPTION

At the discretion of the Engineer, Cement Stabilized Sand meeting the following specification may be allowed as trench backfill.

135.02 MATERIALS

1. Cement: Type I Portland Cement conforming to ASTM C150.
2. Sand: Clean durable sand meeting grading requirements for fine aggregates of ASTM C33, and the following requirements:
 - a) Classified as SW, SP, or SM by the United Soil Classification System of ASTM D2487.
 - b) Deleterious materials:
 - i) Clay lumps, ASTM C142; less than 0.5 percent.
 - ii) Lightweight pieces, ASTM C123; less than 5.0 percent.
 - iii) Organic impurities, ASTM C40; color no darker than standard color.
 - iv) Plasticity index of 4 or less when tested in accordance with ASTM D4318.
3. Water: Potable water, free of oils, acids, alkalies, organic matter, or other deleterious substances, meeting requirements of ASTM C94.

135.03 SUBMITTALS

Mix Design

135.04 CONSTRUCTION METHODS

1. Design Requirements

Design sand-cement mixture to produce a minimum unconfined compressive strength of 50 pounds per square inch in 48 hours and 100 pounds per square inch in 7 days when compacted to 95% in accordance to ASTM D558 and when cured in accordance with ASTM D1632, and tested in accordance with ASTM D1633. Mix for general use shall contain a minimum of 1-½ sacks of cement per cubic yard. Mix for use as sanitary sewer embedment within 9 feet of waterlines shall contain 2 sacks of cement per cubic yard. Compact mix with moisture content between 0% to 2% above optimum.

The maximum compressive strength in 7 days shall be 400 psi. Backfill that exceeds the maximum compressive strength shall be removed by the contractor.

2. Mixing

- a) Thoroughly mix sand, cement, and water in proportions specified by the Design Requirements using a pugmill-type mixer. The plant shall be equipped with automatic weight controls to ensure correct mix proportions.
- b) Stamp batch ticket at plant with time of loading directly after mixing. Material not placed and compacted within 4 hours after mixing shall be rejected.

3. Placement

- a) Place sand-cement mixture in 8-inch-thick lifts and compact to 95% of ASTM D558 unless other specified by the engineer. The moisture content during compaction shall be between 0% to 2% above optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water at plant.
- b) Do not place or compact sand-cement mixture in standing or free water.

135.05 TESTING REQUIREMENTS

1. Mixing plant inspections may be performed periodically. Material samples shall be collected and tested for change in material characteristics.
2. Random samples of delivered product will be taken in the field at point of delivery for each day of placement in the work area. Specimens will be prepared in accordance with ASTM D1632 and tested for compressive strength in accordance with ASTM D1633.
3. The cement content may be tested at the discretion of the City.

135.06 MEASUREMENT

Cement-stabilized sand shall be considered a part of the backfill requirement for the unit installed and shall be considered subsidiary to the length of the unit bid. If the cement stabilized sand is indicated to be a separate construction item for bulk backfill then the cement stabilized sand shall be measured per cubic yard as indicated on the plans.

SPECIFICATION NO. 140

GROUT FILL EXISTING LINE

140.01 DESCRIPTION

This item shall govern the grout filling of existing lines where specified and/or shown on the Plans. All work shall conform to this specification

140.02 MATERIALS

Materials shall conform to Specification 152, Mortar and Grout

140.03 SUBMITTALS

- A. Mix Design
- B. Work Plan

140.04 CONSTRUCTION METHODS

140.04.1 EXECUTION

Prior to grout filling the line, the Contractor shall verify that no live services remain connected to the line. Services found during this procedure shall be paid for using the "Sanitary Sewer Service" item. All live services shall be reconnected to an adjoining main line.

"Grout Fill Existing Line" shall require that an existing underground conduit (pipe, waterline, sewer line, storm drain line, etc.) be completely filled with a low strength cement grout. In order to achieve this, the grout to be pumped into the line shall have a consistency that will permit forced flow into the entire length of line. Blocking the line by intermediate excavation and gravity flow concrete or grout is NOT acceptable. The existing line to be grout filled shall be exposed and plugged with concrete bulkheads at both ends. In some cases this will require the excavation of the existing line and that the pipe be broken open. 3" Schedule 40 PVC shall extend through the bulkhead and using a 90 degree elbow extend up to the surface on both ends of the line to be grouted. The concrete grout shall be pumped through the 3" PVC until the grout is visible at the other end of the conduit through the 3" PVC. No more than 15 psi shall be used to pump the grout mixture, and care should be used to avoid grout filling adjoining voids.

140.04.2 ALTERNATE EXECUTION

At the option of the Contractor, the existing line may be removed from the ground and disposed of properly. Hazardous materials removed from the ground shall require a receipt from a site certified to accept hazardous material. When this option is used, the surface must be restored to existing or better condition per the drawing details for trench embedment. Restoration of the trench and surface is subsidiary to the price of "Grout Fill Existing Line."

140.04.3 COMPOSITION

The proportions by volume or weight of cement, fine aggregate and water shall produce a plastic mixture. The degree of workability shall be consistent with the use to which the mixture is placed, and shall be approved by the Engineer. The mix shall contain no coarse or medium aggregates and shall contain at least two sacks of cement per cubic yard of grout.

140.04.4 EQUIPMENT

All equipment, tools and machinery used in handling and mixing grout shall meet the approval of the Engineer. Grout shall be machine mixed in a batch type mixer.

140.04.5 REJECTION

“Grout Fill Existing Line” may be rejected for failure to meet any of the requirements of the Specifications, and specifically for:

1. Failure to successfully pump grout to the other end of the line.
2. Grout attaining initial set before use.
3. Improper mixing.

If the grout filling is rejected because of “A”, all line not filled shall be removed from the ground and the trench repaired per the drawing details for trench embedment at the Contractor’s expense.

140.05 TESTING REQUIREMENTS

(NOT USED)

140.06 MEASUREMENT

Where “Grout Fill Existing Line” is measured for payment the unit of measurement will be linear feet of line grouted, complete and in place. Payment shall be at the unit price bid in the Proposal. Unless otherwise specified or directed, mortar and/or grout will not be measured as pay quantities but will be included in the unit price bid for the specific item or items into which they are incorporated as set forth in the bid Proposal. The price for this item shall be full compensation for furnishing all equipment, labor, materials, tools and incidentals necessary to complete the work.

SPECIFICATION NO. 150

CONCRETE FOR STRUCTURES

150.01 DESCRIPTION

This specification shall govern for Portland cement concrete to be used in concrete pavement, concrete structures and other concrete construction.

150.02 MATERIALS

A. PORTLAND CEMENT:

Cement shall be Type I or Type III Portland Cement conforming to ASTM C150, or Type IA or Type IIIA, conforming to ASTM C175 except as noted below.

1. Different types of cement, as prescribed above may be used in the same structure, but all cement used in any one monolithic placement shall be of the same type and brand.
2. Type III cement shall not be used when the anticipated air temperature for the succeeding 12 hours will exceed 60 F.

B. FLY ASH:

Fly Ash shall be Type C Fly Ash in accordance with ASTM C618. When fly ash is used, "cement" shall be defined as "cement plus fly ash". "Cement plus fly ash" shall be composed of Type I, II or III Portland cement and 20 to 35 percent fly ash by absolute volume, except that for classes of concrete which are specified to have less than five (5) sacks of Portland cement per cubic yard, the fly ash replacement of cement shall not exceed 25 percent by absolute volume of the specified cement content.

C. AGGREGATE:

1. Concrete aggregate shall conform to ASTM C33.
2. The maximum size of aggregate shall not be larger than one-fifth of the narrowest dimension between forms of the member for which concrete is to be used nor larger than three-fourths of the minimum clear spacing between reinforcing bars.

D. WATER:

Water for use in concrete and for curing shall be from municipal supplies approved by the State Health Department or shall conform to the provisions of AASHTO T26 for quality of water.

E. REINFORCING STEEL:

The reinforcing steel shall be Grade 60

F. STORAGE OF MATERIALS:

1. All cement, fly ash and mineral filler shall be stored in well ventilated weatherproof buildings or approved bins, which will protect them from dampness or absorption of moisture.
2. The method of handling and storing concrete aggregates shall prevent contamination with foreign materials. To assure uniform concrete, aggregate stockpiles shall be maintained at reasonably uniform moisture content.

150.03 SUBMITTALS

- A. Concrete Mix Designs
- B. Certification for cement conformance to specification
- C. Test reports for all required concrete tests

150.04 CONSTRUCTION METHODS

150.04.1 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT:

1. Before placing concrete, all equipment for mixing and transporting the concrete shall be cleaned. All debris shall be removed from the place to be occupied by the concrete.
2. Water shall be removed from place of deposit before concrete is placed unless otherwise permitted by the Engineer.

150.04.2 MIXING OF CONCRETE

1. The concrete shall be mixed until there is a uniform distribution of materials and shall be discharged completely, before the mixer is recharged.
2. For job-mixed concrete, the mixer shall be rotated at a speed recommended by the manufacturer. Mixing shall be continued at least one (1) minute after all materials are in the mixer. Job-mixed concrete shall be rejected and disposed of as directed if not placed as prescribed within thirty (30) minutes after beginning of mixing. Job-mixed concrete is only allowed with written approval from the City Engineer 72-hours prior to the pour.
3. Ready-mixed concrete shall be measured, mixed and delivered in accordance with the requirements set forth in "Standard Specifications for Ready-Mixed Concrete" (A.S.T.M. C-94).

150.04.3 CONVEYING

1. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials.
2. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of a size and design to insure a continuous flow of the concrete at the delivery point, without separation of the materials.

150.04.4 PLACING CONCRETE

1. The Contractor shall give the Engineer sufficient advance notice before placing concrete to permit the inspection of forms, reinforcing steel placement and other preparations

2. Concrete placement will not be permitted when impending weather conditions would impair the quality of the finished work. If conditions of wind, humidity, and temperature are such that concrete cannot be placed without cracking, concrete placement shall be done in the early morning or at night. When concrete mixing, placing and finishing is done in other than daylight hours, provisions shall be made to adequately light the entire placement site. The Engineer will approve the adequacy of such lighting before the operations are begun.
3. Transporting Time: The maximum time interval between the addition of cement to the batch and the placing of concrete in the forms shall conform to the requirements below:

Concrete Temp (at point of placement)	Max Time (No Retarding Agent Minutes)	Max Time (1) (with Retarding Agent) Minutes
Non-Agitated Concrete		
Above 80 F	15	30
80 F and Below	30	45
Agitated Concrete		
Above 90 F	45	75
Above 75 F thru 90 F	60	90
75 F and Below	90	120

4. Cold Weather Precautions

Concrete shall not be placed when the ambient temperature is below 40 F and falling. Concrete may be placed when the ambient temperature is above 35 F and rising, the ambient temperature being taken in the shade and away from artificial heat.

The Contractor shall have available a sufficient supply of approved cotton mats, polyethylene sheeting or other approved covering materials to immediately protect concrete if the air temperature falls to 32 F, or below, before concrete has been in place for less than four (4) hours. Such protection shall remain in place during the period the temperature continues below 32 F, or for a period of not more than five (5) days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at the Contractor's expense.

The surface of all concrete in bents, piers, culvert walls, retaining walls, bottom of slabs, and similar formed concrete shall be maintained at 40 F or above for a period of 72 hours from the time of placements.

The temperature of all concrete, including the bottom slabs (footings) of culverts placed on or in the ground, shall be maintained above 32 F for a period of 72 hours from time of placement.

Protection shall consist of providing additional covering, insulated forms or other means, and if necessary, supplementing such coverings with artificial heating.

4. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The deposition shall be at a rate that allows the concrete to be plastic at all times and permits flow readily into the space between the rebar. Retempered concrete shall not be used and concrete shall not have a free fall of more than five (5) feet, except in the case of thin walls such as in culverts or as specified in other items. Any hardened concrete spatter ahead of the plastic concrete shall be removed.
5. Concrete deposition shall be a continuous operation until completed at the panel or section. Cold joints in a monolithic placement shall be avoided. The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete. Not more than one (1) hour shall elapse between adjacent or successive placements of concrete.
6. Concrete shall be thoroughly consolidated and vibrated in the forms with approved mechanical vibrators of a type considered in the design of forms.

150.04.5 CURING

The concrete shall be kept wet by spraying with water after attaining its final set and before removing the forms. Bottom forms supporting floor or roof slabs shall remain in place for not less than seven (7) days. The concrete shall have attained a compressive strength of not less than 2,000 psi prior to removal of bottom forms. All other forms may be removed twenty-four hours after completion of concrete placement, providing the weather has allowed the concrete to attain its final set in less than five (5) hours. The forms shall be left on for forty-eight (48) hours whenever the temperature of the air in the shade during pouring is 90 degrees F or over. Curing shall be continued for five days after placement of concrete. This may be done with wet mats, with two applications of Type I (White in color) Liquid-Membrane-Forming Compound meeting requirements of ASTM C309, or with waterproof curing paper meeting the requirements of ASTM C171.

150.04.6 CONSTRUCTION JOINTS

Construction joints shall be prepared for receiving the next pour by sweeping the surface of the joint clean with a stiff broom or wire brush to remove all laitance. All loose particles and debris shall be removed. The surface is to be dampened just prior to casting of concrete against the joint. Construction joints will be made only at locations shown on the Plans unless written permission is granted by the Engineer to make additional joints.

150.04.7 EXPANSION JOINTS

Expansion joints shall be of the type and size shown on the Plans. The expansion joint materials shall be a bituminous fiber product or redwood. WR Meadows, Seal tight or approved equal. The joint sealing compound shall be Sonneborn SL-1 or approved equal.

150.04.8 FINISHING

Concrete surfaces shall be finished according to the Plans and Details. The method of finishing shall be according to the Type required as outlined in the Texas Department of Transportation Specifications.

150.05 TESTING REQUIREMENTS

150.05.1 CONCRETE QUALITY AND ALLOWABLE STRESSES

1. CONCRETE QUALITY:

Concrete mixes will be designed and made in sufficient number to represent the required water-cement ratios. These mixes shall comply with the requirements prescribed for strength and consistency as shown below. The Contractor shall furnish the results on trial mixes from a testing laboratory approved by the Engineer.

Minimum Compressive Strength, psi at 28 days	Minimum Cement Content Sack/cu.yd.	Maximum Water Content Gal/sack of cement	General Usage
1,500	3.0	11.0	Riprap
3,000	5.0	6.0	Drilled Shaft;, Culverts (except Top Slab of Direct Traffic Culverts); Inlets; Manholes; Headwalls; Sidewalks; Driveways; curb and gutters;
3,500	5.5	6.0	Concrete Pavement
4,000	6.0	5.0	Bridge slab; Top slab of Direct Traffic Culvert

The slump of concrete mixtures shall be within the following limits when measured according to "Test for Slump of Portland Cement Concrete" (ASTM C142). When admixtures are used to increase the workability, the mix design shall indicate the slump before and after its introduction into the mix.

TYPE OF CONSTRUCTION	COMPRESSIVE STRENGTH OF CONCRETE, psi	MAXIMUM SLUMP
Concrete Pavement	3500	1-3"
Curb and Gutter	3,000	1-3"
Sidewalk	3,000	3-5"
Drilled Shafts and Footings	3,000	5-7"
Thin Walled Sections (9" or less)	3,000	3-5"

150.05.2 TESTS ON CONCRETE

1. During the progress of the work, compression test specimens shall be made and cured in accordance with "Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (ASTM C31). Not less than three specimens shall

be made for each test, nor less than one test for each 50 cu. yds. of concrete of each type placed or for each days pour. These tests shall be made by an independent testing laboratory at the Owner's expense.

2. Specimens shall be tested in accordance with "Standard Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C39).
3. The standard age of test shall be 7 days and 28 days.
4. If the average strength of the control cylinders for any portion of the structure falls below the specified compressive strength, the Engineer shall have the right to order changes in the proportions or the cement content for the remaining portion of the structure. If the concrete minimum 28 day strength is not achieved the Engineer shall have the right to order its removal.
5. An air-entraining admixture may be used with Type I or Type III Portland Cement in lieu of an Air-Entraining Portland Cement. The admixture shall meet the requirements of "Specifications for Air-Entraining Admixtures for Concrete" (ASTM C260). Concrete produced from either Type IA or Type IIIA cement or the use of air-entraining admixtures shall have an air content from 3 to 5 percent when determined by means of the test for air-content, ASTM C231.

150.05.3 TEST CYLINDERS

Preparation of test cylinders and tests on concrete cylinders shall be made at the expense of the Owner. All failed tests shall be charged to the Contractor.

150.06 MEASUREMENT

In general and unless otherwise specified, no separate payment will be made for concrete as an item. The cost of concrete including all materials and equipment, furnishing and placing all reinforcing steel, and performing all labor for the manufacturing, transporting, placing, finishing, and curing of concrete will be included in the unit price bid for specific items as set forth in the Proposal. Payment will not be made for unauthorized work.

SPECIFICATION NO. 152

MORTAR AND GROUT

152.01 DESCRIPTION

Mortar and grout where specified and/or shown on the Plans shall conform to this section of the Specifications. Mortar and grout shall be designated by type as set forth. The uses and purposes of said types shall be consistent with the uses and purposes as designated. For grout filling existing lines please refer to Technical Specification No. 140.

152.02 MATERIALS

- A. Masonry mortar shall be composed of fine aggregate thoroughly mixed with cement and water. The mixture produced shall be homogeneous with a consistency required for ease of handling and spreading by a trowel.
- B. Standard grout shall have a consistency that will permit flow into the joints, completely filling them.
- C. Pipe joint mortar shall have consistency and workability for use as dictated by accepted practices and/or as required for specific job conditions.
- D. Neat cement grout shall be composed of Portland Cement and water mixed to the consistency required for specific job conditions.

152.03 SUBMITTALS

Mix Design

152.04 CONSTRUCTION METHODS

The proportions by volume or weight of cement, fine aggregate and water shall produce a plastic mixture. The degree of workability shall be consistent with the use to which the mixture is placed, and shall be approved by the Engineer.

- A. CEMENT: Cement used in mortar and grout shall be Type I or Type III Portland Cement which shall conform to the current ASTM Designation C-150.
- B. FINE AGGREGATE: Fine aggregate to be used in mortar and grout shall consist of sand or a mixture of sands, with or without a mineral filler. The sand or mixture of sands in fine aggregate shall consist of clean, hard, durable, uncoated grains, free from lumps. Fine aggregate shall not contain deleterious substances in excess of the following percentages by weight:

Material removed by decantation.....	3.0%
Clay lumps	0.5%
Other deleterious substances.....	2.0%
(such as coal, shale, coated grains, and soft, flaky particles)	

Fine aggregate shall be free from an excess of harmful salts or alkali. When subjected to the color test for organic impurities the sand or mixture of sands shall not show a color darker than the standard color. The fine aggregate shall be well graded from coarse to fine, and when tested by laboratory methods shall meet the following requirements for percentages by weight:

Retained on 3/8 inch screen	0%
Retained on 1/4 inch screen	0 - 5%
Retained on No. 20 mesh sieve	15 - 50%
Retained on No. 100 mesh sieve	85 - 100%

Combining two sands of different gradations may be the most economical way to meet these specifications. If this is done, each sand shall be separately and accurately measured by volume or weight in such proportions as the Engineer may direct. Sands and mineral filler shall not be mixed prior to batching. Mineral filler and the use of it shall be approved by the Engineer. In no case shall the added amount of mineral filler exceed ten (10) percent of the weight of the fine aggregate. The mineral filler, when tested by laboratory methods, shall meet the following percentages by weight:

Retained on No. 20 mesh sieve	0%
Retained on No. 30 mesh sieve	0 - 5%
Retained on No. 100 mesh sieve	0 - 30%

- C. WATER: Water for use in mortar and grout shall be reasonably clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances. Water suitable for drinking or ordinary household uses may be considered acceptable for use in mortar and grout.

152.04.01 EQUIPMENT

All equipment, tools and machinery used in handling and mixing mortar and grout shall meet the approval of the Engineer. Mortar and grout shall be machine mixed when the amount required justifies machine mixing. Machine mixers shall be of the batch type.

152.04.02 MIXING

Mortar and grout shall be mixed only in the quantities required for immediate use. Where machine mixing is indicated or directed, the fine aggregate along with the cement and water shall be measured separately, introduced into the mixer, and mixed for a period of time of not less than one and one-half (1 1/2) minutes. This is the time measured from the entry of the last aggregate into the drum until the discharging of mortar or grout. The required water shall be introduced into the mixing drum during the first fifteen (15) seconds of mixing. The entire contents of the drum shall be discharged before introducing any materials for the succeeding batch. Any hand mixing as approved by the Engineer shall be done in an approved watertight box, and the sequence of mixing operations shall be as follows:

The box shall first be filled with the required amount of sand; the sand shall be leveled with the required amount of cement spread uniformly on top of the sand; the materials shall then be dry mixed by turning not less than three (3) times with a mortar hoe; the required amount of water shall then be added and the hoe mixing continued until the batch is of uniform color and consistency.

All mortar and grout shall be used within one (1) hour after mixing or before any visible signs of setting become discernible. Retempering of mortar or grout will not be permitted.

The types, uses and proportions of mortar and grout shall be as follows:

TYPES	USES	SACKS OF CEMENT	CUBIC FEET OF FINE AGGREGATE
"A"	Masonry mortar	1	2
"B"	Standard grout	1	3
"C"	Pipe joint mortar	1	1
"D"	Neat cement grout	1	none

152.04.03 ADMIXTURES

Lime may be added to increase workability in an amount not to exceed ten (10) percent of the cement content of the masonry mortar. Admixtures for the purposes of curing, accelerating the setting, or lowering the freezing point will not be permitted.

152.05 TESTING REQUIRMENTS

Mortar and grout may be rejected for failure to meet any of the requirements of the Specifications, and specifically for:

- A. Retempered mortar and/or grout.
- B. Mortar and grout attaining initial set before use.
- C. Improper mixing.
- D. Mortar and grout containing frozen aggregates.
- E. Mortar and grout subjected to freezing within three (3) days after being placed in the work.

152.06 MEASUREMENT

Where mortar and/or grout are measured for payment the unit of measurement will be cubic yards of mortar and/or grout, complete and in place. Payment shall be at the unit price bid in the Proposal. However, unless otherwise specified or directed, mortar and/or grout will not be measured as pay quantities but will be included in the unit price bid for the specific item or items into which they are incorporated as set forth in the bid proposal.

SPECIFICATION NO. 155

REMOVAL OF EXISTING CONCRETE

155.01 DESCRIPTION

This item shall consist of breaking up, removing and satisfactorily disposing of existing pavement along the right-of-way or at locations shown on the Plans.

155.02 MATERIAL

(NONE)

155.03 SUBMITTALS

(NONE)

155.04 CONSTRUCTION METHODS

Existing pavement (with or without bituminous top), sidewalk, driveway, curb, or combined curb and gutter shall be broken up into pieces not greater than eighteen (18) inches in any dimension by air-driven machinery or other suitable means. The use of explosives will not be permitted.

Where only a portion of the existing concrete is to be removed, special care shall be exercised to avoid damage to that portion of the concrete to remain in place. The existing concrete shall be cut to the neat lines shown on the Plans or established by the Engineer. Any existing concrete beyond the neat lines so established which is damaged or destroyed by these operations shall be replaced at the Contractor's expense.

Existing pavement, which is to be removed, shall be loaded, hauled and neatly stored at designated sites, or otherwise disposed of as directed by the Engineer. Work performed under this item shall be inaugurated at such times and prosecuted in such manner as to cause minimum inconvenience to traffic or to the owners of adjacent property.

155.05 TESTING REQUIREMENTS

(NONE)

155.06 MEASUREMENT

Existing pavement, concrete sidewalk and driveways, removed as prescribed above will be measured by the square yard in its original position, regardless of its thickness or the depth of covering.

Existing combined concrete curb and gutter and concrete curb, removed as prescribed above, will be measured by the linear foot in its original position, regardless of its thickness or the dimensions of same.

The work performed as prescribed by this item and measured as provided under "Measurement", will be paid for at the unit price bid for "Removal of Existing Concrete" (of the type specified), which price shall be full compensation for breaking up of the concrete, loading, hauling, unloading and satisfactorily storing or disposing of the material. Payment shall include all labor, tools and equipment to complete the work. Payment will not be made for unauthorized work.

SPECIFICATION NO. 160

CLEARING AND GRUBBING

160.01 DESCRIPTION

Clearing and grubbing shall consist of the removal and disposal of trees, stumps, brush, roots, vegetation, logs, rubbish and other objectionable matter from the designated portions of the right of way as well as from authorized construction sites.

160.02 MATERIALS

(NONE)

160.03 SUBMITTALS

(NONE)

160.04 CONSTRUCTION METHODS

Designated portions of the right-of-way shall be cleared of all trees, stumps, brush, logs and rubbish, with the exception of trees and brush designated by the Engineer for preservation. Trees and brush designated for preservation shall be carefully trimmed as directed and shall be protected from scarring, barking or other injuries during construction operations. Scars from pruned limbs shall be treated by painting the exposed cuts with an approved asphaltic material.

Areas required for embankment construction, roadway, channel and structural excavation, borrow sites, and material sources shall be cleared and grubbed. On areas required for roadway, channel, or structural excavation, all stumps, roots, etc., (except for designated trees and brush) shall be removed to a depth of at least two (2) feet below the lower elevation of the excavation. On areas required for embankment construction, all stumps, roots, etc., shall be removed to a depth of at least two (2) feet below the existing ground surface. All holes remaining after clearing and grubbing shall be backfilled and tamped as directed by the Engineer. The entire area will be bladed to prevent ponding of water and to provide drainage. In areas to be immediately excavated, the Engineer may direct that the holes not be backfilled. When permitted by the plans, trees and stumps may be cut as close to natural ground as practicable on areas which are to be covered by at least three (3) feet of embankment. On areas required for borrow sites and material sources, stumps, roots, etc., (except for designated trees and brush) shall be removed to the extent necessary to prevent such objectionable matter from becoming mixed with the material to be used in construction.

All cleared and grubbed material shall be disposed in the city or county's landfill, in any legally permitted landfill or in a manner satisfactory to the Engineer.

160.05 TESTING REQUIREMENTS

(NONE)

160.06 MEASUREMENT

Clearing and grubbing will be considered subsidiary to the subsequent bid item unless a specific bid item is provided in the proposal. All work performed in clearing and grubbing areas not so designated on the Plans or in the Special Provisions, will not be paid for directly but shall be considered subsidiary work pertaining to the various bid items. Payment will not be made for unauthorized work.

If included in the bid proposal, all work performed will be paid for at the unit price bid for clearing and grubbing or as a lump sum price according to the bid proposal. Price shall include full compensation for furnishing all labor, equipment, tools, supplies and incidentals necessary to complete the work.

SPECIFICATION NO. 170
POLYVINYLCHLORIDE PIPE AND FITTINGS

170.01 DESCRIPTION

The work specified under this section includes the manufacture, construction and installation of Polyvinylchloride (PVC) pipe and fittings for Water Lines and for Gravity and Pressure Sanitary Sewers.

170.02 MATERIALS

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds (Latest Edition)
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe (Latest Edition)
ASTM F 1483	Standard Specification for Oriented Poly (Vinyl Chloride), (PVCO) Pressure Pipe (Latest Edition)
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM D1598	Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
ASTM D1599	Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2152	Standard Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2564	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

ASTM D2672	Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4-Inch Through 12- Inch for Water Distribution (Latest Edition)
AWWA C909	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe. 4-Inch Through 12-Inch for Water Distribution (Latest Edition)
AWWA C104	ANSI Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
AWWA C105	ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C111	ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C116	Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
AWWA C153	Ductile Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in. for Water Service
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In.-48 In.

170.02.1 WATER LINES

1. PIPE

- a. Blue colored Polyvinyl chloride (PVC) pressure pipe, six (6) inch through twelve (12") inch, shall conform to the current AWWA – C900 or C909 standard, be UL listed, be approved by the Texas State Board of Insurance and the National Sanitation Foundation. C900 will only be accepted as an equal if a letter from the supplier is submitted stating that the C909 pipe cannot be obtained. PVC pipe wall thickness shall be based on a working pressure rating of 125 psi at 100° F (DR-14, Class 200 for C900 or Class 200 for C909.). The outside diameter shall be identical to ductile-iron pipe (CIOD Standard, Table 2, AWWA – C900). All pipe shall be new and have the AWWA designation,

pressure class, DR pressure rating and size of pipe stamped on the outside of each joint (follow requirements of C900 2.5.2 Markings). All piping shall be new. Partial pieces from other projects shall not be approved for installation. Metal detector tape shall be installed above all PVC pipe at an elevation of 2 feet below natural ground.

- b. Blue colored PVC 3" pipe shall be SDR 21, ASTM D2241
- c. PVC Pressure Pipe shall be designed and tested in accordance with ASTM D1598, D1599, and D2152.
- d. Fittings for PVC water pipe shall be ductile-iron, and shall conform to AWWA C153, unless otherwise specified.

Fitting joints shall be mechanical joints. Bolts and nuts for mechanical joints, or flanged ends will be of a high strength corrosion resistant low-alloy steel and shall conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel. All fittings shall be epoxy coated and lined unless stainless steel is used.

Where joints are to be restrained, use mega-lug type fitting.

Polyethylene wrap or encasement of metal fittings shall conform to AWWA C105. Joint tape shall be self sticking PVC or 8-mil-thick polyethylene.

- e. Joints

PVC water pipe shall be furnished with an elastomeric gasket at each joint and an integral thickened bell as part of each joint. Pipe and fittings must be assembled with a non-toxic lubricant. Provisions must be made at each joint for expansion and contraction. Refer to ASTM F477, D3139 and D3212.

170.02.2 GRAVITY SANITARY SEWER

1. PIPE

Flexible pipe and fittings shall be unplasticized polyvinyl chloride gravity sewer pipe shall be green in color, made from clean, virgin, NSF approved Class 12454-B PVC conforming to ASTM D1784. All pipe shall be new and have the ASTM designation, SDR, pressure rating and size stamped on the outside of each joint. All markings shall follow requirements of ASTM D3034.

Polyvinyl chloride (PVC) gravity pipe and fittings in sizes four inch (4") through fifteen inch (15"), shall conform to ASTM D3034, be UL listed and approved by the National Sanitation Foundation. Pipe and fittings shall be SDR-26. Eighteen inch (18") pipe and fittings shall be SDR-26 and conform to ASTM D2241, be UL listed and approved by the National Sanitation Foundation.

170.02.3 SEWER FORCE MAIN AND PRESSURE PIPE

1. PIPE

- a. Polyvinyl chloride (PVC) pressure pipe, three (3) inch through eight (8) inch, shall conform to the current ASTM D2241, AWWA – C900, or AWWA C909 standard, be UL listed, be approved by the Texas State Board of Insurance and

the National Sanitation Foundation. PVC pipe pressure class shall be equal to or greater than twice the maximum calculated pressure of the force main.

- b. Polyvinyl chloride (PVC) pressure pipe shall be SDR-21 Class 200 and conform to the ASTM D2241 standard, be UL listed and approved by the National Sanitation Foundation. The outside diameter shall be identical to steel pipe.
- c. PVC Pressure Pipe shall be designed and tested in accordance with ASTM D1598, D1599, and D2152.
- d. Fittings for PVC pressure pipe shall be ductile-iron, and shall conform to AWWA C153, unless otherwise specified. Fitting joints shall be mechanical joints. Bolts and nuts for mechanical joints, or flanged ends will be of a high strength corrosion resistant low-alloy steel and shall conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel. All fittings shall be epoxy coated and lined unless stainless steel is used. Polyethylene wrap or encasement of metal fittings shall conform to AWWA C105. Joint tape shall be self sticking PVC or 10-mil-thick polyethylene.

Where joints are to be restrained, use mega-lug type fitting.

- e. Joints: PVC water pipe shall be furnished with an elastomeric gasket at each joint and an integral thickened bell as part of each joint. Pipe and fittings must be assembled with a non-toxic lubricant. Provisions must be made at each joint for expansion and contraction. Refer to ASTM F477, D3139 and D3212.

170.03 SUBMITTALS

- A. Submit manufacturer's data on pipe furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance," stating that the materials furnished comply with this specification.

170.04 CONSTRUCTION METHODS

Inspection, Storage and Handling

A. UNLOADING - COLD WEATHER HANDLING

As the temperature approaches and drops below freezing extra care should be used in handling during cold weather. Pipe at the bottom of a stack may become out-of-round due to the weight of material above it. Allow the pipe to recover to full initial roundness before installation. Pipe may be unloaded by hand, either by passing over the side or off the truck end. Sliding one length on another is permissible in unloading pipe, but lengths in the bottom layer shall be lifted off of the rough surface of the truck body to avoid abrasion. Compact shipping units (palletized bundles in a wood frame) may be unloaded by conventional fork lifts.

B. STOCKPILES

Store pipe on a flat surface so as to support the barrel evenly with bell ends overhanging. Store random lengths separately where they will be readily available. Individual lengths of pipe should be stacked in piles no higher than 5 feet. Pipe shall be protected during long exposures (over 3 months) to sunlight. Do not use clear plastic sheets. Provide for air circulation under sheet.

C. STORING RUBBER RINGS

Store all rubber rings at a central point and distribute them as needed. Keep them clean, away from oil, grease, excessive heat and electric motors which produce ozone. If rubber rings are not to be used immediately, store them in their cartons, as shipped, in a cool dark place out of the direct rays of the sun.

D. TRENCH WIDTH

See Standard Details.

E. JOINT ASSEMBLY

1. Push-on joints shall be assembled as follows:

- a. Thoroughly clean the groove and bell and insert the gasket, making sure that it faces the proper direction and that it is correctly seated.
- b. Dirt or foreign material shall be cleaned from the spigot end to a point one inch (1") beyond the reference mark. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.
- c. Be sure that the spigot end is beveled, as square or sharp edges may damage or dislodge the gasket and cause a leak. Push the spigot end into the bell of the pipe while keeping the joint straight. Brace the bell while the beveled end is pushed under the ring, so that previously completed joints in the line will not be closed up. Make deflection after the joint is assembled.
- d. Push the spigot end in until the reference mark on the spigot end is flush with the end of the bell. If excessive resistance to insertion of the beveled end is encountered or the reference mark does not reach the flush position, disassemble the joint, and check the position of the ring. If it is twisted or pushed out of its seat, clean the ring, bell and beveled end and repeat assembly. Be sure both lengths are in proper alignment. If the ring was not out of position, measure the distance between the reference mark and beveled end, and check it against correct values from the manufacturer. Relocate the reference mark if it is out of position.
- e. Small pipe can be pushed into the bell end with a long bar. Large pipe requires additional power, such as a jack, lever puller, or backhoe. A timber header should be used between the pipe and jack or backhoe bucket to avoid damage to the pipe.
- f. At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug, or other means approved by the Engineer. The plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water

2. Mechanical joints shall be assembled as follows:
 - a. Wipe clean the bell and spigot end. The spigot end, bell, and gasket should be washed with a soap solution to improve gasket seating.
 - b. Place the gland on the spigot end with the lip extension toward the spigot end, followed by the gasket with the narrow edge of the gasket toward the spigot end of the pipe.
 - c. Insert the pipe into the bell and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly. Make deflection after joint assembly but before tightening the bolts.
 - d. Push the gland toward the bell and center it around the pipe with the gland lip against the gasket.
 - e. Align bolt holes and insert bolts, with bolt heads behind the bell flange, and tighten opposite nuts to keep the gland square with the bell.
 - f. Tighten the nuts in accordance with manufacturer's recommendations.
3. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, or where long radius curves are permitted, the amount of deflection shall not exceed that shown in Table 1. Pipes greater than twelve-inches (12") in diameter shall not be deflected.

TABLE 1 Maximum Deflection Full Length Pipe Push-on Type Joint		
Pipe Diameter in.	Deflection Angle Deg.	Minimum Radius of Curve ft. *
6	2.5	230
8	1.9	300
12	1.3	450

* All curvature results from the bending of pipe lengths. There is no deflection at the joint.

4. Cutting and Beveling
 - a. A square cut is essential to insure proper assembly. Use either a tubing cutter or a miter box and carpenter's fine-toothed hand saw or hacksaw. (Do not use standard pipe cutters. The cutting wheel will crush or damage the pipe.)
 - b. Use a factory-finished beveled end as a guide to determine the angle and length of taper. The end may be beveled using a Pilot beveling tool which will cut the correct taper automatically or a thin steel, "cheese-grater" type of hand tool, Stanley "Sureform" No. 399.
 - c. With a pencil or crayon, locate the reference mark at the proper distance from the bevel end as indicated by the manufacturer.

F. POLYETHYLENE TUBE PROTECTION

All cast iron and ductile iron fittings shall be provided with 8 mil polyethylene tube protection. Completely cover all fittings and connections with polyethylene film held securely in place with joint tape or strapping according to the provisions of AWWA C105..

G. EMBEDMENT

Install embedment as shown on the Plans and in accordance with Specification No. 130.

I. TAPPING WATER LINES

Where a tap occurs within a deflected section of pipe, utilize a fitting (ie: 8" x 1" tapped tee) in lieu of tapping the pipe.

The tapping sleeve specified will be the Smith-Blair 662 Stainless Steel Tapping Sleeve with Epoxy Coated Flange for pipe sizes 6"-24".

J. GRAVITY SANITARY SEWER DEFLECTION TEST

The sewer line shall be tested for deflection in accordance with SPECIFICATION NO. 490 TESTING FOR SANITARY SEWAGE GRAVITY SYSTEM.

170.05 TESTING REQUIREMENTS

See: Specification No. 490, "Testing of Gravity Sewer Systems"
Specification No. 690, "Hydrostatic Testing" (Used for Waterlines & Sanitary Sewer Force Mains)
Specification No. 695, "Disinfection of Waterlines"

170.06 MEASUREMENT

Payment shall be made at the price bid per unit length per the specification TECHNICAL SPECIFICATION NO. 600 WATER MAIN CONSTRUCTION or TECHNICAL SPECIFICATION NO. 400 SANITARY SEWAGE SYSTEM.

SPECIFICATION NO. 180

DUCTILE IRON PIPE

180.01 DESCRIPTION

The work specified under this section includes furnishing all labor, tools, equipment, materials, and supplies for the installation of Ductile Iron Pipe for Water Lines or Sanitary Sewers.

180.02 MATERIALS

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A746 Standard Specifications for Ductile Iron Gravity Sewer Pipe (Latest Revision)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104 Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water (Latest Edition)

AWWA C105 Polyethylene Encasement for Ductile Iron Pipe Systems (Latest Edition)

AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings (Latest Edition)

AWWA C115 Flanged Ductile Iron Pipe with Threaded Flanges (Latest Edition)

AWWA C116 Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service

AWWA C151 Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids (Latest Edition)

AWWA C150 Thickness Design of Ductile Iron Pipe (Latest Edition)

AWWA C153 Ductile Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in. for Water Service

AWWA C600 Ductile Iron Water Mains (Latest Edition)

180.02.1 WATER LINES

1. PIPE

Ductile iron pressure pipe shall conform to the current AWWA C151 (ANSI A21.51) standard. All pipe shall be new, and shall have the AWWA or ASTM designation, pressure class and size of pipe stamped on the outside of each joint. Ductile iron pipe shall be approved by the Underwriter's Laboratory and shall be accepted by the State Fire Insurance Board for use in water distribution systems without penalty. Ductile iron pipe less than six (6") inches in diameter will not be allowed

Ductile iron thickness shall conform in all respects to the current AWWA C150 standard based on a minimum of 200 psi working pressure. A special design shall be provided for large diameters or deep embedments.

Flanged pipe shall conform to AWWA C115 and be based upon a minimum of 200 psi working pressure.

Foreign made pipe shall not be accepted.

2. JOINTS AND GASKETS

All ductile iron pressure pipe shall be furnished with one of the following types of joints, and as described in the Proposal, or shown on the Plans.

<u>Type Joint</u>	<u>Standard</u>
Push-on Joint	AWWA C111
Mechanical Joint	AWWA C111
Flanged Ends	AWWA C115

Flange gaskets shall be full faced and conform to Appendix A of AWWA C115.

3. FITTINGS

Fittings for ductile iron pipe shall be of cast iron, or ductile iron, and shall conform to AWWA C153, unless otherwise specified in the proposal, special specification, or on the plans.

Fitting joints shall be push-on, mechanical, flanged, or special internally locked joint with body thickness and radii of curvature conforming to AWWA C153.

All screwed flanges shall be ductile iron.

4. BOLTS AND NUTS

Bolts and nuts for mechanical joints shall be of a high strength corrosion resistant low alloy steel and conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel.

5. POLYETHYLENE ENCASEMENT

Polyethylene encasement of 8 mils thickness shall conform to AWWA C105. Joint tape shall be self sticking PVC or polyethylene, 8 mils thick.

6. RESTRAINT

See Specification No. 120

7. COATINGS

Pipe exterior to be bituminous coated and in accordance with the requirements of AWWA C151 Section 4.3. Coating and Lining or epoxy coated in accordance with AWWA C116.

8. LINING

Unless otherwise noted, all pipe shall be cement-mortar lined inside with seal coat all in accordance with AWWA C104 or epoxy coated in accordance with AWWA C116.

180.02.2 GRAVITY SANITARY SEWER LINES

1. PIPE

- a. Ductile iron gravity and pressure pipe shall conform to the current ASTM, A746, and AWWA C111 and C151 (ANSI A21.51) standard. All pipe shall be new, and shall have the AWWA or ASTM designation, pressure class and size of pipe stamped on the outside of each joint. Ductile iron pipe less than eight (8") inches in diameter will not be allowed for sewer mains.
- b. Ductile iron thickness shall conform in all respects to the current AWWA C150/C151 standard, based on a minimum of 200 psi working pressure.
- c. Pipe to be shipped in accordance with the pipe manufacturer's recommendations and stored in a manner that the pipe is not damaged. The Contractor will replace damaged piping at no additional cost to the City.
- d. Flanged pipe shall conform to AWWA C115, and be based upon a minimum of 200 psi working pressure.

2. JOINTS AND GASKETS

All ductile iron pressure pipe shall be furnished with one of the following types of joints, and as described in the Proposal or shown on the Plans. Flange gaskets shall be full faced, and conform to Appendix A of AWWA C115.

<u>Type Joint</u>	<u>Standard</u>
Push-on Joint	AWWA C111
Mechanical Joint	AWWA C111
Flanged Ends	AWWA C115

- a. All screwed flanges shall be ductile iron.
- b. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

3. FITTINGS

- a. Fittings for ductile iron pipe shall be of ductile iron, and shall conform to AWWA C153.
- b. Fitting joints shall be mechanical, flanged, or special internally locked joint with body thickness and radii of curvature conforming to AWWA C153.

4. BOLTS AND NUTS

Bolts and nuts for mechanical joints shall be high-strength corrosion resistant low alloy steel, and conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts shall be 316 stainless steel.

Mechanical joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

5. POLYETHYLENE ENCASEMENT

Polyethylene encasement shall conform to AWWA C105. Joint tape shall be self-sticking PVC or polyethylene, 8 mils thick.

6. COATINGS/ LININGS

All pipe and fittings shall be bituminous or epoxy coated outside and inside, all in accordance with AWWA C104 or AWWA C116. Interior lining for ductile iron sewer pipe shall conform to manufacturer's recommendations. Minimum lining thickness shall be 40 mils, regardless of material recommended.

Other acceptable lining materials are "Protecto 401" Ceramic Epoxy by Vulcan Group or approved equal.

180.02.3 FORCE MAIN

Force mains shall comply with of all requirements of Section 180.02.01 Waterlines.

180.03 SUBMITTALS

- A. Submit manufacturer's data on pipe furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance," stating that the materials furnished comply with this specification.

180.04 CONSTRUCTION METHODS

A. INSPECTION, STORAGE, AND HANDLING

- 1. Pipe to be shipped in accordance with the pipe manufacturer's recommendations and stored in a manner that the pipe is not damaged. The Contractor will replace damaged piping at no additional cost to the City.
- 2. Pipe shall not be stacked higher than manufacturer's recommendations. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two (2) rows of 4" x 4" timbers shall be placed between tiers and chocks affixed to each end in order to prevent movement.

3. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.
4. Mechanical joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

B. TRENCH WIDTH

See Spec 130 Trenching for details.

C. PIPE INSTALLATION

All pipe fittings, services, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the material. All rejected material must be removed from the project immediately at the sole expense of the Contractor.

All lumps, blisters, and excess coating shall be removed from the socket and plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit or any foreign material before the pipe is laid.

Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.

At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug, or other means approved by the Engineer. The plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.

D. JOINT ASSEMBLY

Push-on joints shall be assembled as follows:

Thoroughly clean the groove and bell socket and insert the gasket, making sure that it faces the proper direction and that it is correctly seated.

After cleaning dirt or foreign material from the plain end, apply lubricant in accordance with the pipe manufacturer's recommendations. The lubricant is supplied in sterile cans, and every effort should be made to keep it sterile.

Be sure that the plain end is beveled; square or sharp edges may damage or dislodge the gasket and cause a leak. When pipe is cut in the field, bevel the plain end with a heavy file or grinder to remove all sharp edges. Paint bare surfaces with proper coating. Push the plain end into the bell of the pipe. Keep the joint straight while pushing. Make deflection after the joint is assembled.

Small pipe can be pushed into the bell socket with a long bar. Large pipe requires additional power, such as a jack, lever pull or backhoe. A timber header should be used between the pipe and jack or backhoe bucket to avoid damage to the pipe.

E. MECHANICAL JOINT ASSEMBLY

Wipe clean the socket and plain end. The plain end, socket and gasket should be washed with a soap solution to improve gasket seating.

Place the gland on the plain end, with the lip extension toward the plain end, followed by the gasket, with the narrow edge of the gasket toward the plain end of the pipe.

Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly. Make deflection after joint assembly, but before tightening the bolts.

Push the gland toward the bell, and center it around the pipe with the gland lip against the gasket.

Align bolt holes and insert bolts, with bolt heads behind the bell flange, and tighten opposite nuts to keep the gland square with the socket.

Tighten the nuts in accordance with the manufacturer's recommendations.

When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, or where long radius curves are permitted, the amount of deflection shall not exceed manufacturer's recommendations.

F. PIPE CUTTING

Cutting pipe for the insertion of valves, fittings, or closure pieces shall be done in a neat, workmanlike manner, without creating damage to the pipe or lining. Seal-coat bare surfaces and cut ends per manufacturer's recommendations.

Cut ends and rough edges shall be ground smooth, and for push-on joint connections, the cut end shall be beveled.

G. POLYETHYLENE TUBE PROTECTION

1. GENERAL

All cast iron & ductile iron pipe and fittings shall be provided with polyethylene tube protection according to the provisions of AWWA C105. Completely cover all fittings and connections with polyethylene film held securely in place with joint tape or strapping. The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material.

Where polyethylene-wrapped pipe joints an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least two (2') feet. Secure the end with circumferential turns of tape.

H. EMBEDMENT

Install embedment as shown on the Plans and in accordance with Specification No. 130.

I. REACTION ANCHORAGE AND BLOCKING

The contractor shall install concrete blocking and retaining glands to all unlugged bell and spigot or all-bell tees, Y-branches, bends deflecting eleven and one-fourth degrees ($11\frac{1}{4}^\circ$) or more, and plugs which are subject to internal pressure in excess of 10 psi. to preclude separation of joints. See SPECIFICATION NO. 120, CONCRETE BLOCKING OR ANCHORAGE for additional details.

J. MINIMUM COVER

See TECHNICAL SPECIFICATION NO. 600 WATER MAIN CONSTRUCTION or TECHNICAL SPECIFICATION NO. 400 SANITARY SEWAGE SYSTEM for cover requirements.

180.05 TESTING REQUIREMENTS

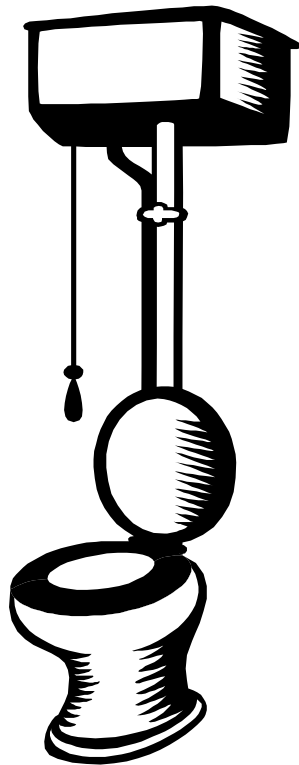
See: TECHNICAL SPECIFICATION NO. 600 WATER MAIN CONSTRUCTION or TECHNICAL SPECIFICATION NO. 400 SANITARY SEWAGE SYSTEM for testing requirements.

180.06 MEASUREMENT

Payment shall be made at the price bid per unit length per the specification TECHNICAL SPECIFICATION NO. 600 WATER MAIN CONSTRUCTION or TECHNICAL SPECIFICATION NO. 400 SANITARY SEWAGE SYSTEM.

TECHNICAL SPECIFICATIONS

Sanitary Sewer



SPECIFICATION NO. 400
SANITARY SEWAGE SYSTEM

400.01 DESCRIPTION

This is a general specification, which applies to the furnishing of all plant, labor, equipment, appliances and materials and in performing all operations in connection with the construction of sanitary sewers, together with the manholes, cleanout structures and other incidentals, in accordance with the plans and these specifications.

400.02 MATERIALS

See:

Specification No. 110, "Pipe Boring, Jacking, & Tunneling"

Specification No. 130, "Excavating, Trenching, & Backfill"

Specification No. 170, "PVC Pipe & Fitting"

Specification No. 180, "Ductile Iron Pipe"

Specification No. 440, "Manholes"

Specification No. 460, "Sewer Services"

400.03 SUBMITTALS

All submittal requirements are listed with the material specifications

400.04 CONSTRUCTION METHODS

Construction methods for each material are specified in the material specifications.

A. Minimum Cover

The desired minimum cover for sanitary sewer pipe shall be six feet (6') as measured from the outside top of pipe vertically to finished ground or pavement surface elevation. The minimum cover shall be three and one half feet (3.5'). Where the cover is 3.5', ductile iron pipe should be used and cement stabilized sand backfill where erosion may occur.

400.05 TESTING REQUIREMENTS

See:

Specification No. 490, "Testing of Gravity Sewer Systems"

400.06 MEASUREMENT

Payments will be made at the price bid per foot for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including line fittings, trenching, and backfill, embedment, compaction or tamping, sterilization, testing, final cleanup, and all other work not otherwise provided for in bid proposal. Pipe will be measured (by horizontal distance) from center of fitting to center of fitting, or end of pipe without deduction for the length of intermediate fittings.

SPECIFICATION NO. 440

MANHOLES

440.1 DESCRIPTION

This item shall govern the manufacture, construction, and installation of sanitary sewer manholes. All manholes shall conform to TCEQ requirements. Submittal and approval shall be required for all pre-cast design.

440.02 MATERIALS

A. Concrete

Refer to Specification 150

B. Manhole Rings and Covers

The standard rings and covers (V-1420) and the water-tight ring and cover (V-2420) shall be manufactured by East Jordan Iron Works (or approved equal.) The manhole shall bear the appropriate model number, the logo of City and the words "Sanitary Sewer". The cover shall have pick lugs cast into the surface. All manhole ring and covers shall have a 32" diameter.

C. Grade Rings

Grade rings shall be precast reinforced concrete. Minimum thickness shall be 2 inches by 8 inches wide by 30 inches inside diameter.

D. Precast Reinforced Manhole Sections

Precast manhole sections conform to the current ASTM C478 standard. Joints shall be O-ring gasketed. Thickness for manhole risers shall be as listed under wall "B" in the "Class Tables" of ASTM C76, Reinforced Concrete Pipe.

E. Pre-cast Manhole Bases

Pre-cast manhole bases will conform to all TCEQ requirements and City Specifications for invert depths, reinforcement, base thickness and manhole depth for pipe size.

F. Drops

Drops shall be constructed of ductile iron as specified in Specification No. 180, "DUCTILE IRON PIPE", encased in concrete as shown on the plans. All pipe segments adjacent to the manhole shall be restrained using retainer glands or restrainer gaskets. Cement stabilized sand may be used for backfill as well as PVC pipe as specified in Specification No. 170 "POLYVINYLCHLORIDE PIPE AND FITTINGS."

440.03 SUBMITTALS

A. Submit manufacturer's data on materials furnished indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.

B. Submit manufacturer's "Certificate of Compliance" stating that the materials furnished comply with this specification.

440.04 CONSTRUCTION METHODS

440.04.01 MANHOLE BASES

1. Construct manhole bases in the configuration shown on the Plans. Minimum thickness below the flowline of sewer shall be 8 inches or as shown on the details.
2. Insure that bases are constructed or installed on firm ground and that ground water is controlled. Install appropriate material for a minimum of 4" to stabilize bottom if directed to do so by the Engineer.
3. The invert of manholes shall be formed in such a fashion that they are smooth and will not obstruct flow of sewage. Provide flow channels in the manhole base equivalent to the top of the pipe by forming the concrete base and trowelling it to a smooth, even finish with a steel trowel. Slope the manhole bench from the wall line to edge of flow channel and trowel it smooth on a grade of 1 inch per foot with a liberal radius applied at flow channel intercepts.

440.04.02 PRECAST MANHOLES

1. Precast Manhole bases shall be placed on a 6" minimum depth layer of cushion sand, gravel or approved material.
2. Cast bottom section of precast manhole riser ring in manhole base as shown on the Plans. Place "Synko-Flex" waterstop (or approved equal) per manufacturer's recommendations prior to setting precast starter ring.

The base shall have a minimum diameter 12 inches greater than the outside diameter of the manhole, and a minimum thickness including the area under the pipe as follows:

0' to 8' manhole	- 6"
greater than 8'	- 12"

3. All invert channels shall be smooth and accurately shaped to a semi-circular bottom conforming to the outside of the adjacent sewer section. Inverts shall be formed directly in the concrete of the manhole base or may be constructed by laying full section sewer pipe straight through the manhole and cutting out the top half after the base is constructed. Changes in the direction of the sewer and entering branches shall have a true curve of as large a radius as the size of the manhole will permit. Where the largest pipe at a manhole is less than 12", the channel depth shall be one half of the largest pipe diameter. When the largest pipe at the manhole is between 12 and 24 inches (inclusive,) the channel depth shall be three fourths of the largest pipe diameter. When the largest pipe at a manhole is greater than 24", the channel depth shall match the largest pipe. In all cases, the edges of the pipe along the invert and at the walls of the manhole shall be plastered and brush-finished. Plaster shall be non-shrink or hydraulic grout.

4. Where inlet leads, main or lateral pipe sewers enter manholes, pipes shall be cut off flush with inside of manhole any irregularities shall be grouted up with non-shrink grout. Install stub outs, where shown, to line and grade. Use one full joint of pipe, of size indicated, for stub out. Seal stub out with plug. Install plug in such a manner as to prevent seepage of leakage through stub outs. Installation of plug shall be such that it may easily be removed in future without damaging bell or groove end of stub out.
5. If manholes are constructed in streets where immediate subsequent paving or repaving is involved, readjust the manhole ring and covers, immediately prior to the paving operations. Manholes shall be installed with joints of size and numbers required to obtain correct depth. Contractor is responsible for verifying correct manhole depth before construction. Initially, manhole tops shall be not less than 6-inches nor greater than 18-inches from final grade. If manholes are relocated in the field because of unforeseen conflicts, the Contractor is responsible for correct depth of manhole. Manhole tops shall be set as follows:
 - a. Developed Areas: Set manhole tops 1-inch higher than existing elevation of natural ground or other final grade when specified by the Engineer.
 - b. Undeveloped Areas: Set manhole tops flush with paved surfaces and 6-inches higher than shoulder and/or proposed final grade elevations in easements or other unpaved areas. Where manholes are located in bottom of ditches, either set manhole top by EJIW V-2342, or approved equal, flush with ditch bottom and seal with solid cover, or set twelve inches above ditch top and reshape ditch around manhole.
6. Prior to placing each section of manhole riser or cone, thoroughly clean the bells and spigots to be joined.
7. Backfilling will be performed evenly and carefully around the manhole after the full strength of the concrete is attained.
8. Carefully place the O-ring gasket and check for proper alignment.
9. Plug lift holes, interior joints, and exterior joints with "Water Plug" grout.
10. Each manhole shall be individually vacuum tested according to the Specification No. 440. Stub-outs, boots, and pipe plugs shall be secured to prevent movement while the vacuum is being drawn.

440.04.03 CAST-IN PLACE MANHOLES

Cast-In place manholes are not allowed without prior approval from the City Engineer. This approval shall only be in emergency situations.

440.04.04 CAST-IN PLACE MANHOLES

Fiberglass manholes are permitted with written approval from the City Engineer.

440.04.05 SERVICE CONNECTIONS

Service connections at manholes will meet all other requirements of this specification and shall be tied into the manhole with a manhole boot. At the time of construction, the Engineer will designate the locations of the service outlets and the depth to the top of the

lateral pipe, if depth is not indicated on the plans. The minimum depth of cover over the end of the lateral pipe shall be four feet.

440.04.06 CLEANOUT STRUCTURES

The Contractor shall construct cleanouts where shown on the plans and as specified. All backfill around and above the pipe shall be machine tamped in layers not exceeding 3-inches in depth so that no settlement shall occur after the cleanout is constructed. Cleanouts shall be provided at each service connection and located at the edge of an easement or at the right-of-way. The cleanouts shall be enclosed within a meter box which has a lid that makes the cleanout accessible set flush with the ground.

440.04.07 DROP MANHOLES

Drop manholes shall be constructed for elevation differences of 30 inches or greater as measured from the flow line of the pipe to the flow line entrance of the manhole.

Drops shall be constructed as shown on the plans. Concrete for encasement shall have a twenty-eight (28) day strength of 2,000 psi. Ductile iron pipe and fittings shall be wrapped per Specification No. 170, "Ductile Iron Pipe." Cement stabilized sand may be used for backfill as well as PVC pipe as specified in Specification No. 170 "POLYVINYLCHLORIDE PIPE AND FITTINGS."

440.05 TESTING REQUIREMENTS

See Specification No. 490, "Testing of Gravity Sewer Systems"

440.06 MEASUREMENT

- A. The depth of manholes completed shall be determined by measuring the vertical distance from the flow line of the sewer main to the top of the manhole ring and cover.
- B. Standard manholes shall be measured by the each for various size diameters and depths.
- C. The contract unit prices shall be the total compensation for furnishing all labor, materials, tools, equipment, and incidentals and performing all work, of whatever nature required, that is necessary for the completion of the manholes in accordance with the provisions of the plans and these specifications. Material or methods used to stabilize the foundation shall be subsidiary to the bid item for Manholes.
- D. Cleanouts for services shall be considered subsidiary to the price for each service connection.
- E. Drop connections will be measured for payment per each, complete in place regardless of depth.

SPECIFICATION NO. 450

CONNECTION OF NEW LINES TO EXISTING MANHOLES

450.01 DESCRIPTION

This item shall govern for the connecting of new sewer lines to existing manholes, where so indicated on the Plans or as directed by the Engineer.

450.02 MATERIALS

(NOT USED)

450.03 SUBMITTALS

(NOT USED)

450.04 CONSTRUCTION METHODS

Where new sewer lines are to be connected to existing manholes, holes of the proper size and at the proper location shall be cored into the existing manholes. Where it is necessary to provide a smooth flow through the manhole, the bottom of the manhole shall be shaped to conform to the bottom of the pipe as directed by the Engineer.

Other methods in lieu of coring may be used and should be discussed with the City Engineer prior to performing. The City Inspector should be notified at the beginning of either of these processes.

If the manhole can not satisfactorily be cored due to its condition, a hole shall be cut into the existing manhole. The sewer pipe shall be inserted into the hole cut in the manhole so that the end of the pipe will be flush with the inside of the manhole and the pipe shall be made smooth and water-tight with a Type "A" mortar.

450.05 TESTING REQUIREMENTS

(NOT USED)

450.06 MEASUREMENT

Connecting new sewer lines to existing manholes will be paid for at the unit price bid in the Proposal for each connection made. The price will be full remuneration for making the connection complete, including cutting the hole in the manhole, shaping the bottom of the manhole of necessary, grouting the pipe and including the furnishing of all equipment, labor, materials, power, tools, and incidentals necessary to complete the work, except the pipe.

SPECIFICATION NO. 490

TESTING FOR SANITARY SEWAGE GRAVITY SYSTEM

490.01 DESCRIPTION

This is a general specification, which applies to the furnishing of all labor, materials, tools, and equipment to perform all operations in connection with leakage testing for completed manholes and gravity sewer pipe and deflection testing for flexible sewer pipe.

490.02 MATERIALS

(NOT USED)

490.03 SUBMITTALS

(NOT USED)

490.04 CONSTRUCTION METHODS

The Contractor shall notify the City Engineer or his representative when the manholes and line are ready to be tested. After the City Engineer or his representative concurs that the line is ready to be tested, the Contractor may proceed with testing. The Contractor will supply and set-up the test plugs and risers for the test and will perform the test in the presence of the City Engineer or his representative.

Contractor shall take such precautions as required to prevent damage to lines and appurtenances being tested. Damage resulting from tests shall be repaired at Contractor's expense.

490.05 TESTING REQUIREMENTS

490.05.1 MANHOLE TESTING

After completion of manhole construction, wall sealing, or rehabilitation, test manholes for leakage using Vacuum Testing or, if approved by the City Engineer, Exfiltration Testing Procedures as specified herein.

1. GENERAL

Plug influent and effluent lines, including service lines, with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required in this test; follow Manufacturer's safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls.

2. VACUUM TESTING

a. Performance:

Depth (ft)	Diameter, in.								
	30	33	36	42	48	54	60	66	72
	Time, s								
=8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	30	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30+	42	45	53	63	74	87	98	108	121

b. Execution

Install Vacuum Tester Head Assembly at top access point of manhole, top of frame, and adjust for proper seal on straight top section of manhole frame. Following Manufacturer's instruction and safety precautions, inflate sealing element to recommended maximum inflation pressure. Evacuate manhole with vacuum pump to 10 inches of Mercury (Hg). Then disconnect pump and monitor vacuum for the time period specified in 490.05.1-1-a. "Performance." Drop in vacuum should not exceed 1 inch Hg over the specified time period.

3. EXFILTRATION TESTING

a. Performance:

Manhole Depth	Maximum Allowable Water Loss
0 to 8 feet	1 inch over 15 minutes
Over 8 feet	1/8 inch per vertical foot of depth over 15 minutes

b. Execution

Fill the manhole with water up to the manhole cover. Monitor elevation for the time period specified in 490.05.1-3-a "Performance".

490.05.2 GRAVITY PIPE LEAKAGE TESTING

1. GENERAL

Tests shall be made by the low-pressure air test, the infiltration test or the joint test. The infiltration test shall be used when the groundwater level is at least 2 ft above the crown of the pipe measured at the upstream manhole. The joint test shall be used for pipe sections greater than 36-inch inside diameter. The Contractor may use the joint test for pipe with a 27-inch through 36-inch average inside diameter at the approval of the Engineer or his representative. The low-pressure air test, the infiltration test and the exfiltration test shall be conducted from manhole to manhole. Trenches shall be completely backfilled and sewer line should be free of debris prior to testing. Plug all pipe outlets including laterals and secure plugs to prevent leakage blowout due to testing pressure.

2. INFILTRATION TEST

a. Performance

The total infiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. For construction within the 100-year flood plain, the total infiltration shall not exceed ten gallons per inch diameter per mile of pipe per 24 hours.

NORMAL CONSTRUCTION

SIZE OF PIPE	ALLOWABLE LEAKAGE* Gal/Min/100 Ft.
6"	0.0039
8"	0.0053
10"	0.0066
12"	0.0079
15"	0.0099
18"	0.0118
21"	0.0138
24"	0.0158
27"	0.0178
30"	0.0197
36"	0.0237

* Equivalent to 50 gal. per inch diameter per mile per 24 hours

CONSTRUCTION WITHIN 100 YR FLOOD PLAIN

SIZE OF PIPE	ALLOWABLE LEAKAGE* Gal/Min/100 Ft.
6"	0.0008
8"	0.0011
10"	0.0013
12"	0.0016
15"	0.0020
18"	0.0024
21"	0.0028
24"	0.0032
27"	0.0036
30"	0.0039
36"	0.0047

* Equivalent to 10 gal. per inch diameter per mile per 24 hours

The total leakage in cubic inches shall be the total cross-sectional area in square inches of the inside of the two risers and of any stacks in the sewer multiplied by the drop in water level in inches. For diameters not listed in chart, multiply the square of the diameter by the following chart value for 1" diameter.

DIAMETER OF RISER OR STACK	VOLUME PER INCH OF DEPTH	
	Cubic Inch	Gallon
1"	0.7854	.0034
2"	3.1416	.0136
2-1/2"	4.9087	.0212
3"	7.0686	.0306
4"	12.5664	.0544
5"	19.6350	.0850
6"	28.2743	.1224
8"	50.2655	.2176

b. Execution

Stop all dewatering operations and allow the groundwater to return to its normal level and allow to remain so for at least 24 hours. Leakage shall be determined by measuring the flow through the opening in the downstream plug for at least 15 minutes. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage in excess of that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.

3. AIR TEST

a. Performance

The pipe shall be pressurized to 3.5 pounds per square inch gauge (psig) greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 psig to 2.5 psig shall be computed from the following equation:

$$T = (0.085 \times D \times K) / Q$$

T = time for pressure to drop 1.0 pound per square inch gauge (seconds)

K = $0.000419 \times D \times L$, but not less than 1.0 (SF)

D = average inside pipe diameter (inches)

L = length of line of same pipe size being tested (feet)

Q = rate of loss, 0.0015 cubic feet per minute per square foot internal surface shall be used (CFM/SF)

Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as follows:

Pipe Diameter (inches)	Minimum Time (min:sec)	Length for Minimum Time (feet)	Time for Longer Length (seconds)
6	5:40	398	0.855(L)
8	7:34	298	1.520(L)
10	9:27	239	2.374(L)
12	11:20	199	3.419(L)
15	14:10	159	5.342(L)
18	17:00	133	7.693(L)
21	19:50	114	10.471(L)
24	22:40	100	13.676(L)
27	25:30	88	17.309(L)
30	28:20	80	21.369(L)
33	31:10	72	25.856(L)

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined in this subparagraph or until failure.

b. Execution

Add air until the internal air pressure of the sewer line is raised to approximately 4 psig. Allow the air pressure to stabilize. The pressure will normally drop until the temperature of the air in the line stabilizes.

When the pressure has stabilized and is at or above the starting test pressure of 3.5 psig, commence the test by allowing the gage pressure to drop to 3.5 psig at which point the time recording is initiated. Record the drop in pressure for the test period.

4. JOINT TEST

The joint test may be conducted by an air test or water test. The joint and the pipe segment shall be visually inspected immediately after testing.

a. Performance

The pipe is to be pressurized to 3.5 psig greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psig to 2.5 psig shall be ten seconds.

If the groundwater pressure is equal to or greater than 3.5 psig, and the sewer line or joint is not leaking the sewer line or joint is acceptable and no additional testing is required. If one or more joints are leaking, but the total amount of leakage in the sewer line being tested is equal to, or less than, the allowable leakage specified in 250.03-B-1 "Performance", the line is acceptable and no additional testing is required provided visible leaks are repaired. Moisture or beads of water appearing on the surface of the joint will not be considered as visible leakage.

b. Execution

Review proper operation, safety, and maintenance procedures as provided by the manufacturer of the joint test apparatus. Move the joint test apparatus into the sewer line to the joint to be tested and position it over the joint. Make sure the end element sealing tubes straddle both sides of the joint and the hoses are attached. For the water test, the bleed-off petcock must be located at top dead center. Inflate end element sealing tubes with air in accordance with equipment and manufacturer's instructions.

- i) Air Test - Pressurize the void volume with air to 3.5 psig greater than the pressure exerted by groundwater above the pipe. The drop in pressure shall be measured over ten seconds. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage in excess of that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.

- ii) Water Test - Introduce water into void volume until water flows evenly from open petcock. Close the petcock and pressurize with water to 3.5 psig above the pressure exerted by ground water. The drop in pressure shall be measured over ten seconds. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage in excess of that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.

490.05.3 DEFLECTION TESTING

Deflection tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27 inches and greater, a method approved by the Engineer shall be used to test for vertical deflections. Other methods shall provide a precision of two tenths of one percent (0.2%) deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5.0%. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices.

1. MANDREL SIZING

The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. All dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

2. MANDREL DESIGN

The rigid mandrel shall be constructed of a metallic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

3. METHOD OPTIONS

Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case-by-case basis. Mandrels with removable legs or runners may be accepted on a case-by-case basis. Mechanical devices will not be used to pull the mandrel.

490.05.4 TV CAMERA INSPECTION

T.V. Camera Inspection shall be performed on all sewer pipe installed before acceptance. When the Contractor performs the inspection, the City Engineer or his representative shall be notified one working day prior so that he can view the procedure. The tape shall be given to the City Engineer or his representative for review and final records.

The lines shall be completely filled with potable water between manholes to fill the service connections and drained prior to T.V. Camera Inspection. Jetting of the lines in conjunction with the T.V. Inspection is prohibited. If the line to be televised is discovered to contain foreign material, which prohibits an acceptable T.V. inspection, the line shall be jetted and televised again.

Select and use closed circuit television equipment that will produce a color video tape. Produce and use closed circuit television equipment using a panorama tilt, radial viewing, pipe inspection camera that pans plus and minus 75 degrees and rotates 360 degrees. The camera must have an accurate footage counter. Video tapes shall be continuous from pipe segments between manholes. Provide tapes with labels indicating project number, segment number, date televised, date submitted, starting manhole number, ending manhole number, pipe diameter, pipe length and street name.

The T.V. inspection shall be used to identify defective construction such as sags, debris, separated joints, etc. The City Engineer shall make all final determinations if the severity of the defect constitutes failure and subsequent removal of the segment in question.

490.05.5 RETESTS

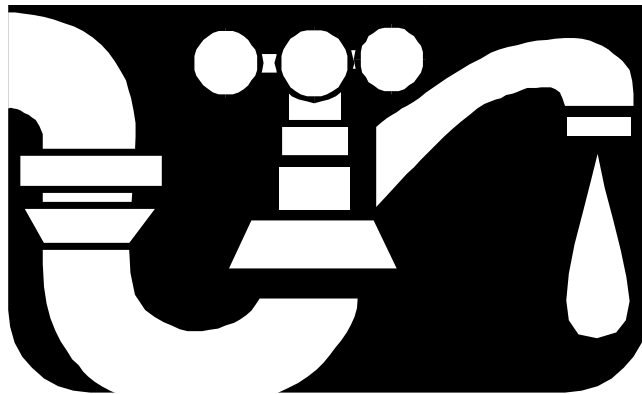
Manholes or sewers which fail to meet the testing requirements shall be repaired and retested by the Contractor. All repairs and retesting shall be performed at the expense of the Contractor.

490.06 MEASUREMENT

Testing of sewer lines (except for T.V. Inspection), manholes and appurtenances shall not be considered a separate pay item. T.V. Inspection will be paid for as a separate bid item. The Contractor shall supply all water for the tests, all equipment and labor necessary to convey the water into the sewer, the necessary transportation to transport test plugs and risers from one test site to another and such labor and equipment as may be required in installing test plugs, and other incidental work in conducting the tests and the cost thereof shall be included in the price for constructing the sewer, including furnishing the test plugs.

TECHNICAL SPECIFICATIONS

Domestic Water



TECHNICAL SPECIFICATION NO. 600

WATER MAIN CONSTRUCTION

600.01 DESCRIPTION

This item shall govern the construction of water mains including trenching, backfilling, pipe-laying, coupling, testing, the setting of fittings, valves and valve boxes, fire hydrants, appurtenances and wet connections. All work is to be done in accordance with the plans and specifications and paid for in accordance with the schedule of prices submitted in the Proposal.

600.02 MATERIALS

See:

Specification No. 110, "Pipe Boring, Jacking, & Tunneling"

Specification No. 120, "Concrete Blocking or Anchorage"

Specification No. 130, "Excavating, Trenching, & Backfill"

Specification No. 170, "PVC Pipe & Fittings"

Specification No. 180, "Ductile Iron Pipe"

Specification No. 620, "Valves"

Specification No. 640, "Fire Hydrants"

Specification No. 660, "Water Services"

600.03 SUBMITTALS

All submittal requirements are listed with the material specifications

600.04 CONSTRUCTION METHODS

Construction methods for each material are specified in the material specifications.

A. Minimum Cover

The minimum cover for water pipe = 12" in diameter shall be four feet (4') as measured from the outside top of pipe vertically to finished ground or pavement surface elevation. For water pipe > 12" shall be greater than six feet (6') as measured from the outside top of pipe vertically to finished ground or pavement surface elevation unless otherwise directed by the City Engineer. If no curb is proposed or existing, measure cover from the top of pipe to the existing street grade or natural ground, unless otherwise indicated on the plans or directed by the Engineer.

600.05 TESTING REQUIREMENTS

See:

Specification No. 690, "Hydrostatic Testing" (Used for Waterlines & Sanitary Sewer Force Mains)

Specification No. 695, "Disinfection of Waterlines"

600.06 MEASUREMENT

A. Pipe

Payments will be made at the price bid per foot for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation including trenching, and backfill, embedment, compaction or tamping, sterilization, testing, final cleanup, and all other work not otherwise provided for in bid proposal. Pipe will be measured (by horizontal distance) from center of fitting to center of fitting, or end of pipe without deduction for the length of intermediate fittings or valves.

B. Fittings

Payment will be made at the unit price bid per each for furnishing and installing fittings and joint accessories. Fittings will be measured per each.

C. Thrust Blocking

Thrust blocking shall not be a measured item.

D. Services

Services shall be measured per each. Payment for each service will include the furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including line fittings, trenching, and backfill, embedment, compaction or tamping, sterilization, testing, final cleanup, and all other work not otherwise provided for in bid proposal. See Detail or Specification No. 660 for supplementary information.

SPECIFICATION NO. 620

MAIN LINE VALVES

620.01 DESCRIPTION

This section describes the manufacture, construction, and installation of waterline valves for ordinary waterworks service.

620.02 MATERIALS

620.02.1 APPLICABLE STANDARDS

1. AWWA – C110, C111
2. ASTM – A48, C33, C150 and C478

620.02.2 GATE VALVES

All gate valves six (6") inch through sixteen (16") inch shall conform to the current AWWA C515 standard. All valves shall be cast iron body, resilient seat nonrising stem, internal wedging type and new. All gate valves shall have a square nut operated valve turning clockwise to close. Brass is not allowed. Valves shall have a working pressure rating of 250 psi.

1. Resilient-Seated Gate Valves per AWWA C515

a. General

All valves six (6") inch through twelve (12") inch shall have a bronze stem, resilient-seated disc, drip tight shutoff. Valves shall be manufactured by American Flow Control Series 2500 and be "Resilient Seated" (Powder Coated), or approved equal.

b. Gates, Rings and Disc

All gates shall be cast-iron with internally reinforced, molded rubber disc seat rings. All gate valves shall be manufactured with a modified wedge disc with steel reinforced, natural rubber disc seat ring. Disc shall slide on a vertical, machined guide surface and shall seat on a sloped, machined seating surface. Valves shall be tested for leakage per AWWA C515, Section 6.1.6.

- ###### **c. Gate valves six (6) inches through eight (8) inches will be installed seated on a minimum of one (1) 12"x12"x 4" solid concrete blocks. Valves larger than 12" will be seated by a poured-in-place concrete saddle. The size of this saddle is as shown on the plans.**

2. Stuffing Boxes

All valves six (6") inches through sixteen (16") inches shall be equipped with double O-rings, provided arrangement is made for replacement under pressure of the upper O-ring when the valve is fully open. All geared valves will be equipped with conventional packing in the main stuffing box. Valves shall be installed in a vertical position. Stuffing box and bonnet bolts and nuts shall be 304 stainless steel.

3. Handwheels and Operating Nuts

All valves four (4") inches in diameter and above shall be nut operated, unless otherwise ordered. Handwheels shall be furnished only when called for on plans, or on valves three (3") inches and smaller. All valves shall open by turning to the left (counter clockwise). Operator nuts shall be two (2") inch square.

4. Miscellaneous Requirements

- a. All exposed bolts, nuts, etc., for valves to be buried, shall be stainless steel. Cadmium plated bolts, nuts, etc., will not be accepted.
- b. A valve nut extension will be installed when the operating nut is located 5' or more below finished grade after valve installation.

620.02.3 BUTTERFLY VALVES

1. Butterfly valves shall only be allowed on waterlines 18" and larger as approved by the City Engineer. Butterfly valves shall be American Darling, Mueller Line Seal III, or Pratt Triton XR, and shall have "bi-directional shutoff". Butterfly valves shall conform to the current AWWA C504 standard and as modified herein.
2. The valve body is to be constructed of cast-iron or ductile-iron, and shall be short body. Valves shall be Class 150B. Valve shafts shall be stainless steel and not pass through the seat. Valve discs shall be ductile iron with stainless steel disc edge. Seat seals shall be located in the body and be Buna N or natural rubber and replaceable. Shaft seals shall be Chevron type packing of double O-rings. Bearings shall be self-lubricating type made from teflon, nylon or sintered bronze. All bolts, nuts, etc., shall be stainless steel. Cadmium plated bolts, nuts, etc., will not be accepted.
3. Manual butterfly operators shall conform to the current AWWA C504 standard, as modified herein. The valve shall close by turning the input shaft clockwise. All handwheels or nuts shall turn clockwise to close the valve. On valves intended for buried service, all exposed bolting material shall be stainless steel, including all operator flange and gland bolts. Operator housings shall be tightly gasketed and sealed against infiltration of groundwater. Manual operators equipped with a handwheel or crank shall have a mechanical advantage such that a forty (40#) pound pull on the handle or wheel rim will develop the required operating torque.

620.02.4 VALVE ENDS

1. Valves shall have flanged, push-on, or mechanical joint ends, or any combination of these, as may be specified or shown on the plans. Push-on joint or mechanical joint ends shall conform to AWWA C111. Flanged ends shall conform to ASA B16.1, Class 125 lb. (unless otherwise noted).
2. Bolts and nuts for mechanical joints will be of high-strength low-alloy corrosion resistant steel and conform to AWWA C111. All mechanical joint glands will be ductile iron.
3. Bolts and nuts for flanged ends buried in the ground shall be Type 304 stainless steel.

620.02.5 OPERATOR EXTENSION SHAFTS

Operator extension shafts are required on all valves when the operating nut is over five (5') feet below finished grade. Extension shaft is to bring the operating nut to within six (6") inches of the top of the valve box. Extension shaft shall be bolted to valve operating nut with stainless steel bolt.

620.02.6 VALVE BOXES

A valve box shall be furnished and installed over each underground valve. The boxes shall be Tyler/Union cast iron of the two-piece screw type, with a shaft diameter of not less than five and one-fourth inches (5-1/4"). Provide extension stem for all buried valves terminating in a standard 2-inch square AWWA nut within twelve inches (12") of valve box cover. All parts of the valve box, base and cover shall be coated with hot bituminous varnish. The box shall be furnished complete with cast iron cover and yoke to fit over the valve body. Concrete valve box collars (24"x24"x6") shall be installed with each gate valve. Valve boxes are to be installed plumb and adjusted to their proper grade by the Contractor.

620.02.7 BRASS PLUG VALVES

One-half (1/2") inch through two (2") inch plug valves, when shown on the plans or required, shall be of all brass construction, and warranted for a water working pressure of 200 pounds per square inch. Brass plug valves smaller than two (2") inches shall be Mueller Oriseal, or approved equal. Two (2") inch brass plug valves shall be Mueller Oriseal Mark II, or approved equal.

620.02.8 CONCRETE

Cement shall conform to ASTM C150, Type 1. Aggregates shall conform to ASTM C33. Twenty-eight (28) day compressive strength shall equal or exceed 3,000 psi.

620.03 SUBMITTALS

- A. Submit manufacturer's data on materials furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance", stating that the materials furnished comply with this specification.

620.04 CONSTRUCTION METHODS

A. Installation

Any and all instruction manuals supplied by the manufacturers should be reviewed in detail before installation of the valve. At the job site, prior to installation, the valve should be visually inspected and any foreign material in the interior portion of the valve should be removed. A detailed inspection of the valve should be performed prior to installation.

- 1. All bolts should be protected to prevent corrosion, either with a suitable paint or by polyethylene wrapping.
- 2. During installation, there exists the possibility of foreign materials inadvertently entering the valve. Valves should be installed in the closed position. The valve shall be seated on

a minimum of one (1) 12"x12"x 4" solid concrete blocks. Valves larger than 12" will be seated by a poured-in-place concrete saddle in the trench to prevent settling and excessive strain on the connection to the pipe. Size of this saddle shall be shown on the plans.

3. A valve box or vault should be provided for each valve used in a buried service application. The valve box should be installed so as not to transmit shock or stress to the valve. The valve box should be centered over the operating nut of the valve, with the box cover flush with the surface of the finished area, or such other level as directed by the City. Butterfly valves utilizing smaller bypass valves shall have a watertight manhole constructed as shown on the plans. Valve boxes should be of such a design that a traffic load on the top of the box is not transmitted to the valve.
 4. Valves buried in unusually deep trenches shall have extension stems for operating the valve.
- B. Valves installed above ground or in plant piping systems should be supported in such a way as to minimize bending of the valve end connections as a result of pipe loading.
- C. After installation and before pressurization of the valve, all pressure-containing bolting (bonnet, seal plate, bypass, and end connections) should be inspected for adequate tightness to prevent leakage. In addition, an inspection should be made for adequate tightness to prevent leakage. In addition, an inspection should be made for adequate tightness of all tapped and plug openings to the valve interior. Proper inspection at this time will minimize the possibility of leaks after pressurization of the piping system.
- D. In order to prevent time lost searching for leaks, it is recommended that valve excavations not be backfilled until after pressure tests have been made.
1. If valves are used to isolate test section, the test pressures should not exceed twice the rated working pressure of the valve. After the test, steps should be taken to relieve any trapped pressure in the body of the valve. The valve should not be operated in either the opening or closing direction at differential pressures above the rated working pressures.
 2. Test butterfly valves against closed valve during hydrostatic testing to insure "driptight" closure in both directions. Correct leaky valves per manufacturer's recommendations.
- E. Upon completion of the installation, valve location, size, make, type, date of installation, and other information deemed pertinent should be entered on permanent records and given to the Engineer.
- F. Valves should not be installed in applications or for service other than those recommended by the manufacturer.
1. Valves should not be installed in lines where service pressure will exceed the rated working pressure of the valve.
 2. Mainline valves shall not be used for throttling service, unless the design is specifically recommended for that purpose or approved in advance by the manufacturer and Engineer.
 3. Double-disc gate valves should not be installed inverted or with the stems sloped more than forty-five (45) degrees from upright, unless the valve was ordered and manufactured specifically for that orientation.
 4. Valves should not be used in applications for water distribution that is exposed to subfreezing temperatures unless sufficient flow is maintained through the gate valve to prevent freezing, or some other type of protection is provided to prevent freezing.

5. Valves should not be installed at the dead end of a pipeline without proper and adequate restraint to support the valve and prevent it from blowing off the end of the line.
6. To prevent damage to the valve, gate valves, six inches (6") to sixteen inches (16") in diameter shall not be operated with input torques greater than 300 ft.-lbs. Butterfly valves should not be operated with input torques greater than sixty (60) ft.-lb.

620.04.1 INSPECTION, STORAGE, AND HANDLING

1. All valves should be unloaded carefully. The valve should be carefully lowered from the truck to the ground, not dropped. In the case of larger valves, fork trucks or slings around the body of the valve or under the skids should be used for unloading. Only hoists and slings with adequate load capacity to handle the weight of the valve or valves should be used. Do not hook hoists into or fasten chains around bypasses, yokes, gearing, motors, cylinders, or handwheels.
2. Valves should be inspected at the time of receipt for damage in shipment. The initial inspection should verify compliance with specifications, direction of opening, size and shape of operating nut, number of turns, and type of end connections. A visual inspection of gate rings and body rings should be performed to detect any damage in shipment or scoring of the seating surfaces. Inspection personnel should look for bent stems, broken handwheels, cracked parts, missing parts and accessories, and any other evidence of mishandling during shipment. The valve should be cycled through one complete opening-and-closing cycle. All valves sixteen (16") inches and larger should be operated through one full operating cycle in the position in which they are to be installed.
3. Valves should be stored in the fully closed position to prevent entry of foreign material that could cause damage to the seating surfaces. Whenever practical, valves should be stored indoors. If outside storage is required, means should be provided to protect the operating mechanisms, such as gears, motor operators, and cylinders, from the weather and foreign materials. If valves may be subject to freezing temperatures, remove water from the valve interior and close the gates tightly before storage. Valves in outside storage in cold climates should be stored with the discs in a vertical position; if the discs are in a horizontal flat position, rain water can accumulate on top of the top disc, seep into the valve body cavity, freeze, and crack the casting. Any valves damaged by weather will not be installed.

620.05 MEASUREMENT

A. Gate Valves and Butterfly Valves

Gate valves and butterfly valves will be measured by the each.

Payment will be made at the unit price bid per each for furnishing and installing gate valves, which bid price will include all costs for the complete gate valve installation, including extension stems, valve boxes, concrete blocking, testing, and disinfection.

Payment will be made at the unit price bid per each for furnishing and installing butterfly valves, which bid price will include all costs for the complete butterfly valve installation shown on the plans, including extension stems, valve boxes, concrete blocking, manhole, brass plug valves, bypass plumbing, corporation cocks, special fittings, testing, disinfection, and all other associated work not otherwise provided for in the Proposal.

B. Appurtenances

Operator extensions, valve boxes, brass plug valves, manholes, and concrete blocking will not be measured items.

SPECIFICATION NO. 640

FIRE HYDRANTS

640.01 DESCRIPTION

This section describes the manufacture, construction, and installation of fire hydrants.

640.02 MATERIALS

640.02.1 APPLICABLE STANDARDS

1. AWWA –C110, C111, C502, and C600
2. ASTM – C33 and C105

640.02.2 GENERAL

All fire hydrants furnished shall conform to the current AWWA C502 standard, as modified by this specification. Fire hydrants shall meet all test requirements and be listed by Underwriters Laboratories, Inc and shall meet all test requirements and have full approval of Factory Mutual. Acceptable fire hydrants are American Flow Control - American Darling B-84-B, and Mueller Centurion.

1. Pressure rating -- working pressure shall be 250 psig tested to 500 psig hydrostatic pressure.
2. Flow -- friction loss shall not exceed 2.113 psig at a flow of 1000 gpm through the pumper nozzle connection when tested as prescribed in AWWA C-502 latest revision. This test must be conducted by an independent laboratory in their facility and attested to by a Professional Engineer. Documentation must accompany all requests for hydrant approval.
3. Barrel and shoe -- Lower barrel and shoe shall be of ductile iron.
4. Type shut-off – compression with or against flow.
5. Inlet connection – 6 inch, mechanical joint per AWWA C110 and C111.
6. Joint gland bolts – high strength, low-alloy steel per AWWA C111, Section 11-6.5.
7. Bolts, studs, and nuts in contact with soil - stainless steel.
8. Drain valve -- fully positive and automatic. The drain system must be free from toggles and any other services that may require field adjustments. Both valve and seat ring drain shall have no less than two (2) openings. Both shall be force flushed during the opening cycles, but are sealed when the hydrant is fully opened by utilizing two urethane drain valve facings.
9. Inlet valve – 5-1/4” minimum with "resilient-seat" urethane rubber facing.
10. Outlet – two-2-1/2” hose nozzles, one 4-1/2” pumper nozzle; all National Standard Hose Coupling Thread. All nozzles shall be bronze and thread into the nozzle section with o-ring seals and held in place with an acceptable locking device. The nozzles shall thread into the nozzle section in such a manner that the nozzle connection will

- be tightened when the caps are removed. Twist and lock or slip and lock nozzles will not be accepted.
11. Operating nut – National Standard pentagon; 1-1/2" from point to flat at base of nut; bronze.
 12. Direction to open – counter clockwise.
 13. Turns to open – not less than ten (10).
 14. Flanges – 7/8" thick.
 15. Operating stem – steel, ASTM A-576.
 16. Stem seals – double rubber O-ring against bronze surface.
 17. Exterior paint – red machinery enamel.

640.02.3 ADDITIONAL REQUIREMENTS

1. Breakable Type Construction

Hydrants shall be traffic-model type. The break coupling shall be steel tubing. The coupling design shall pull out when the hydrant is struck by an automobile. Cast iron couplings are not allowed. Cast iron couplings shatter on impact and parts can fall into the hydrant lower barrel. The safety flange shall be located on the lower barrel side of the flange to eliminate the likelihood of fragmented ring parts dropping into the lower barrel. The traffic feature must allow a full 360 degree facing of the nozzles by infinite degrees.

2. Provisions for Extension

All hydrants shall be capable of being extended to accommodate future grade changes without excavation. Compression type hydrants that close with the flow shall have breakable type stem coupling installed at the ground line flange. Extension of this type hydrant shall be made by adding at the ground line flange, a new coupling and stem section equal to the length of the extension. Stem extensions made by adding a new section of stem to the threaded section of the stem at the top of the hydrant will not be accepted. Only one extension is allowed.

3. Bury Length

Furnish hydrants for a four (4') foot bury unless the water line grades shown on the plans indicate a deeper bury is required.

4. Operating Stems

Operating stems whose threads are located in the barrel or waterway shall be of manganese bronze, Everdur, or other high quality non-corrodible metal, and all working parts in the waterway shall be bronze to bronze.

Operating stems whose threads are not located in the barrel or waterway may be made of high-grade bronze, genuine wrought iron, or steel, and stem nuts shall be bronze. Iron or steel stems shall have a bronze, stainless steel, or other non-corrodible metal, sleeve where passing through O-rings. Operating threads must be sealed against contact with the water at all times regardless of open or closed position of the main valve.

The operating mechanism, safety stem coupling and main valve assembly shall be capable of withstanding 200 ft-lbs of torque against the fully open or closed

positions, with no damage to the components. Downward stem travel shall be limited in the bottom of the hydrant by a one-piece lower valve plate that bottoms out in the hydrant shoe. Travel stops located in the bonnet or upper valve plate is unacceptable. The interior and the exterior of the hydrant shoe shall be fully coated with not less than 8 mils of fusion bonded epoxy.

5. Main Valve Seats

Main valve seats on compression type hydrants closing with the flow shall be of such design that incorrect positioning is impossible and that the threads will be adequately guided into position. Arrangements shall also be made to hold the main valve gasket in place during assembly. The main seat shall be made of bronze and threaded into a heavy bronze bushing in the hydrant base.

6. Seat and Drain Ring

The bronze seat shall thread directly into a bronze drain ring. This will assure easy removal of the main valve seat through the top of the hydrant shoe and all pressure seals must be o-rings.

7. Hydrant Heads

The hydrant shall be constructed so that the nozzles may be faced in any desired direction.

8. Mating Surfaces

All mating surfaces, such as bonnet-to-nozzle section, nozzle section-to-lower barrel, lower barrel-to-shoe, must utilize rubber gaskets for sealing and must be held in place by zinc-plated bolts and nuts. Other methods, such as snap rings, etc., will not be accepted.

9. Manufacturer Experience Record

No hydrant will be considered which has not been regularly manufactured and in successful continuous use for at least 10 years.

640.02.4 ACCESSORIES REQUIRED

1. Full face ground line flange gaskets.
2. Nozzle cap gaskets
3. Drain valve and outlet
4. Cap nuts to seal the bottom end of stem threads against contact with water
5. Harnessing lugs (Required only when shown on the plans.)
6. Nozzle cap chains

640.03 SUBMITTALS

- A. Submit manufacturer's data on fire hydrants to be furnished indicating compliance with the specifications especially regarding dimensions, materials of construction, and nozzle threads.
- B. Submit manufacturer's "Certificate of Compliance" stating that the materials furnished comply with the specifications.

640.04 CONSTRUCTION METHODS

- A. Fire hydrant leads 18' or shorter will be restrained the entire length. Fire hydrant leads shall require a separate valve for the fire hydrant assembly.

- B. Place fire hydrants at all locations shown on the plans, or as directed by the Engineer.
- C. Set each fire hydrant upon a concrete slab not less than four inches (4") thick and not less than one (1) square foot of surface area.
- D. Place eight (8) cubic feet of crushed rock, clean gravel or other suitable material to provide reservoir capacity so that the hydrant will completely drain when closed.
- E. Set the hydrant perpendicular with large steamer nozzle facing nearest curb, and at a depth such that the center of the steamer nozzle is not less than fifteen inches (15"), nor more than eighteen inches (18") above nearest grade. Assure that the hydrant is sat at the bury line.
- F. Polyethylene encasement of 8 mils thick shall be installed on all piping and appurtenances in contact with soil and shall conform to AWWA C105. Joint tape shall be self sticking PVC or polyethylene, 8 mils thick.

640.05 TESTING REQUIREMENTS

See Specification No. 690 & 695.

640.06 MEASUREMENT

A. Fire Hydrants

Fire hydrants will be measured by the each as shown on the plans.

Payment will be made at the unit price bid per each for furnishing and installing fire hydrants, which bid price will include all costs for the fire hydrant installation, (excluding TEE), hydrant piping and fittings, hydrant gate valve, extension stems, valve boxes, concrete blocking, testing, disinfection, and all other work not otherwise provided for in the Proposal. The main line fitting is not included in the cost of the fire hydrant.

B. Appurtenances

Operation extensions, valve boxes, gate valves, mainline fittings, hydrant piping and fittings, anchor couplings, and concrete blocking will not be measured items and shall be considered subsidiary.

SPECIFICATION NO. 660

WATER SERVICES

660.01 DESCRIPTION

This section describes the manufacture, construction, and installation of water services for ordinary waterworks service.

660.02 MATERIALS

All materials shall be as shown on the details. Service saddles for PVC and Ductile Iron shall be Ford S 90 Series brass saddles for all lines except 3" lines where S 70 Series will be required. All standard service lines shall be Type 'K' Copper. Tapped tee connection shall be ductile iron C153 MJ fitting.

The Corporation Stop shall be Ford Stop No. F1000 cc corp stop. The Curb Stop shall be Ford No. B41-444W, and service wye shall be Y44 264.

660.03 SUBMITTALS

- A. Submit manufacturer's data on materials furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance", stating that the materials furnished comply with this specification.

660.04 CONSTRUCTION METHODS

- A. Installation

Information supplied by the manufacturers on any and all appurtenances should be reviewed in detail before installation of the service. At the job site, prior to installation, the material should be visually inspected and any foreign material in the interior portion of the service should be removed. A detailed inspection of the service should be performed prior to installation.

Service connections shall be tapped tees in curved sections of pipe.

- B. The services should be bedded in a fashion similar to bedding main lines as shown on the details.

660.05 TESTING REQUIREMENTS

(NOT USED)

660.06 MEASUREMENT

Services shall be categorized as "long" if over 15-feet in length or "short" if 15-feet or shorter and measured as "EACH" or as provided in the Bid Proposal Form.

Payment will be made at the unit price bid per each for furnishing and installing services. This unit bid price will include all costs for the complete service installation, including all appurtenances, bedding, marking, testing, and disinfection.

SPECIFICATION NO. 690

HYDROSTATIC TESTS

690.01 DESCRIPTION

This item shall consist of the hydrostatic testing of all waterlines, fire hydrants, and appurtenances.

690.02 MATERIALS

690.02.1 EQUIPMENT PROVIDED BY CONTRACTOR

The contractor shall furnish pump, pipe connections and all necessary apparatus (including gauges and meters) to hydrostatically test the water lines according to this specification.

690.02.2 WATER FOR TESTING

Water for testing will be furnished by the City. All connections of new pipeline must be isolated from existing potable water lines until a negative coliform test report from the County Health Department or TCEQ approved lab has been received.

690.03 SUBMITTALS

(NOT USED)

690.04 CONSTRUCTION METHODS

- A. All water mains including water services shall be hydrostatically tested and sterilized according to Specification No. 695, Disinfection of Waterlines, prior to acceptance by the City.
- B. This section specifies hydrostatic testing of water distribution lines. The contractor shall test waterlines after backfilling, but before replacement of pavement (if applicable.)
- C. Test waterlines in sections, by pressurizing the new system to 150 psi and holding that pressure for a total test time of 4 hours.

690.04.01 PRESSURIZATION

Each valved section of pipe shall be filled with water slowly. The test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City Engineer.

690.04.02 AIR REMOVAL

Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as

the line is filled with water. After all the air has been expelled, the corporation stops shall be closed and the test pressure applied twenty-four (24) hours after filling the line.

At the conclusion of the pressure test, the corporation stops shall be removed and plugged, or left in place at the discretion of the City Engineer. Any added corporation cocks must be shown on as-built plans if they are to remain in place.

690.04.03 EXAMINATION

All exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves or hydrants that are discovered following the test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the City Engineer.

1. Allowable Pressure Loss

a. For DIP and PVC

No pipe installation will be accepted if the water loss is greater than that shown in Table A. No additional leakage will be included for fittings.

b. When hydrants are in the test section, the test shall be made against the closed hydrant and not the valve on the lead.

2. Acceptance of Installation

a. Acceptance shall be determined on the basis of allowable pressure loss. If any test of pipe discloses a pressure loss greater than that specified, the Contractor shall, at his own expense, locate and repair the defective material until the pressure loss is within the specified allowance.

b. All visible leaks are to be repaired, regardless of the amount of pressure loss.

690.06 MEASUREMENT

Testing of waterlines will not be a measured item. Cost for work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work, shall be included in the unit price bid for waterlines in the Proposal.

TABLE A
Loss in Gallons Per Hour Per Foot of Pipe

Length	4"	6"	8"	10"	12"	18"	20"	24"
50	.04	.06	.08	.10	.12	.18	.195	.235
100	.08	.12	.16	.195	.235	.355	.395	.475
200	.16	.235	.315	.395	.475	.71	.785	.945
300	.235	.355	.475	.59	.71	1.065	1.185	1.42
400	.315	.475	.63	.785	.945	1.42	1.58	1.89
500	.395	.59	.785	.985	1.185	1.775	1.975	2.365
600	.475	.71	.945	1.185	1.42	2.13	2.365	2.84
700	.555	.83	1.105	1.38	1.655	2.485	2.76	3.31
800	.63	.945	1.265	1.58	1.895	2.84	3.155	3.785
900	.71	1.065	1.42	1.775	2.13	3.195	3.55	4.26
1000	.79	1.185	1.58	1.975	2.365	3.55	3.945	4.735

Calculations Based on a Loss of 25 Gal./Diameter inch of Pipe/Mile of Pipe/Day

SPECIFICATION NO. 695

DISINFECTION OF WATERLINES

695.01 DESCRIPTION

This specification specifies the procedure for disinfection of water systems, and in general, conforms to AWWA C651, Disinfecting Water Mains including Section 4.3.9.

695.02 MATERIALS

695.02.1 CHLORINE AND WATER

1. Chlorine

Calcium hypochlorite, or equal, which contains seventy (70%) percent chlorine by weight.

2. Water

Water for disinfection will be metered and furnished to the Contractor at no cost. Existing water lines are to remain isolated from newly laid water lines by a physical air gap until the original copy of the negative coliform test results have been received by the City Engineer from either the County Health Department or an approved TCEQ lab.

695.03 SUBMITTALS

(NOT USED)

695.04 CONSTRUCTION METHODS

- A. During the construction operations, workmen shall be required to use utmost care to see that the inside of pipes, fittings, jointing materials, valves, etc., which will come into contact with potable water be maintained in a sanitary condition.
- B. Every effort must be made to keep the inside of the pipe, fittings, and valves free of all foreign matter, sticks, dirt, rocks, etc. As each joint of pipe is being laid, it must be effectively swabbed so that all foreign matter is removed. Placing dry powdered chlorine in the pipeline will be permitted in conjunction with certain methods of sterilization as specified by the Engineer. All fittings and exposed open ends of pipe must be blocked with a plug or capped until the line is completed.
- C. Sterilization of the line, or any section thereof, shall not be commenced until the Engineer has approved the method, apparatus, sterilizing agent, and the section of the line.
- D. When the entire pipeline, or certain section thereof, has been completed, tested, and made ready for use, the line or section of line shall be thoroughly sterilized according to the following procedure:
 - 1. The Contractor shall provide all necessary taps to complete this section of the specifications.

2. The water main shall be flushed prior to disinfection.
3. The flushing velocity shall be greater than 2.5 feet per second. The rate of flow required to produce this velocity in various diameters is shown in Table 1. No site for flushing should be chosen, unless it has been determined by the Engineer or Inspector that drainage is adequate at that site. Flushing is no substitute for preventive measures taken before and during pipe laying. Certain contaminants, especially in caked deposits, resist flushing at any velocity.

TABLE 1

REQUIRED OPENINGS TO FLUSH PIPELINES (40 PSI RESIDUAL PRESSURE)

Pipe Size	Flow (gpm) Required to Produce 2.5 fps Velocity	Orifice Size (in.)	Number of Hydrant Outlet Nozzles	Size (in.) of Hydrant Outlet Nozzles
4	10	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1200	3-1/4	2	2-1/2
16	1565	3-5/8	2	2-1/2
18	1980	4-3/16	2	2-1/2

Note: A 2-1/2" hydrant outlet nozzle will discharge approximately 1,000 gpm and a 4-1/2" hydrant outlet nozzle will discharge approximately 2,500 gpm with 40 psi residual pressure.

E. Methods of Chlorine Application

1. Continuous Feed Method

Note: This method is suitable for general applications.

- a. Water from the existing distribution system, or other approved sources of supply, shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine concentration until the water in the pipe maintains a minimum of fifty milligrams per liter (50 mg/l) available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described herein.

Note: In the absence of a meter, the rate may be determined either by placing a pitot gauge at the discharge, or by measuring the time to fill a container of known volume.

Table 2 gives the amount of chlorine residual required for each 100 feet of pipe of various diameters. Solutions of one percent (1%) chlorine may be prepared with approximately one pound (1 lb.) of calcium hypochlorite (70% strength) in 8.5 gallons of water.

TABLE 2
Chlorine Required to Produce 50 Mg/l
Concentration in 100 feet of Pipe
by Diameter

Pipe Size (in.)	100% Chlorine (lb/100ft)	1% Chlorine Solution (gal/100ft)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
16	0.427	5.12
18	0.540	6.48
24	0.960	11.50
30	1.500	18.00
36	2.160	25.90
42	2.940	35.30

- b. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least twenty-four (24) hours during which time, all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this twenty-four (24) hour period, the treated water shall contain no less than fifty (50) milligrams per liter and no more than one hundred (100) milligrams per liter chlorine throughout the length of the main. A dosage of more than the maximum allowable chlorine will require the Contractor to dilute the flush water with one of the TCEQ approved dilution chemicals. The chemical and description of procedure will be submitted in writing to the Engineer for approval.

2. Slug Method

This method is suitable for use with mains of large diameter for which, because of the volume of water involved, the continuous feed method is not practical.

- a. Water from the existing distribution system shall be made to flow at a constant, measured rate (see C.1.a. Note) into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two (2) rates shall be proportioned so that the concentration of the water entering the pipeline is maintained at no less than 300 milligrams per liter. As the chlorinated water passes along the line, it shall expose all interior surfaces to a concentration of at least 300 mg/L for at least three (3) hours. The application shall be checked at a tap near the upstream and downstream end of the line by chlorine residual measurements made according to the procedures described herein.
- b. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect appurtenances.

3. Dry Treatment during Installation

The dosage and application of sodium hypochlorite will be determined by the following:

- a. Calculate weight of sodium hypochlorite required for water to be treated utilizing Table 2.
- b. Add required amount of solution at the bell of each pipe as it is installed.

F. Final Flushing

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is less than three milligrams per liter (3 mg/l). Chlorine residual determination shall be made by the Inspector to ascertain that the heavily chlorinated water has been removed from the pipeline.

G. Bacteriologic Tests

1. Before the water main is placed in service, a sample or samples shall be collected from points designated by the Inspector and tested for bacteriologic quality. This sample shall be collected 24 hours after final flushing. The test shall show the absence of coliform organisms before the water main may be placed in service. At least one (1) sample per one thousand (1000) feet of new line or portion thereof shall be taken. Sampling shall be supervised by the Inspector. Samples shall be submitted by the city to a TCEQ approved laboratory and/or County Health Department for analysis.
2. Samples of bacteriologic analysis shall be collected in sterile bottles obtained from the Brazos County Health Department. Samples shall be collected at points specified by the City Engineer.
3. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

H. Repetition of Procedure

If the initial disinfection fails to produce samples with no coliform present, the contractor shall re-disinfect the line following the procedures stated in 695.04 of this specification until samples indicating no coliform present have been obtained. When the samples indicate no coliform present and the City Engineer has received original copies of the test report, the main may be placed in service.

695.04.1 PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

The procedure outlined in this section applies primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.

1. Trench "Treatment"

When an old line is opened, either by accident or by design, the excavation will likely be wet and badly contaminated. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

2. Main Disinfection

- a. Swabbing and Flushing. The following procedure is considered as a minimum that may be used.
 - i) Swabbing With Hypochlorite Solution: The interior of all pipe and fittings used to make the repair (particularly couplings and tapping sleeves) shall be swabbed with a 5 percent hypochlorite solution before they are installed.
 - ii) Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.
3. Slug Method: In addition to the swabbing and flushing procedures of section B.1., the section of main in which the break is located can be flushed and chlorinated using the slug method where practical, as determined by the Engineer or Inspector. This method requires isolating the section of main, shutting off all service connections, flushing the main, and chlorinating the main as described in the Slug Method in C.2, except that the dose may be increased to as much as 500 mg/l, and the contact time reduced to as little as ½ hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated.
4. Sampling: Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined by the Inspector. If the direction of flow is unknown, samples shall be taken on each side of the main break.

695.05 TESTING REQUIREMENTS

695.05.1 CHLORINE RESIDUAL-DROP DILUTION METHOD

The drop dilution method of approximating total residual chlorine is suitable for concentrations above 10 mg/L, such as are applied in the disinfection of water mains or tanks.

A. Apparatus

1. A graduated cylinder for measuring distilled water.
2. An automatic or safety pipet
3. A dropping pipet that delivers a one-milliliter (1 ml) sample in twenty (20) drops. This pipet is for measuring the water sample and should not be used for any other purpose.
4. A comparator kit containing a suitable range of standards.

B. Procedure

1. Ascertain the volume of the comparator cell and using an automatic or safety pipet, add 0.5 ml of orthotolidine for each 9.5 ml of distilled water to be added.
2. Using a graduated cylinder, add a measured volume of distilled water.
3. With the dropping pipet, add the water sample a drop at a time, allowing mixing, until a yellow color is formed that matches one of the color standards.

4. Record the total number of drops used and the final chlorine value obtained.
5. Calculate the milligrams per liter residual chlorine as follows:
 - a. Multiply by twenty the number of milliliters of distilled water used in Step 2.
 - b. Multiply product in step a. by the final chlorine value in milligrams per liter recorded in Step 4.
 - c. Divide the product found in step b. by the total number of drops of water sample recorded in Step 4.

695.06 MEASUREMENT AND PAYMENT

Disinfection of waterlines will not be measured. Cost for work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work, shall be included in the unit price bid for waterlines in the Proposal.